Exhibit 31

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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OFFICE OF REGIONAL ADMINISTRATOR

JUL - 1 2019

Shane McCoy, Program Manager
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Anchorage, Alaska 99501

Dear Mr. McCoy:

In accordance with our responsibilities under the National Environmental Policy Act and Section 309 of the Clean Air Act, the U.S. Environmental Protection Agency has reviewed the U.S. Army Corps of Engineers' February 2019 Draft Environmental Impact Statement for the Pebble Project (CEQ Number 20190018; EPA Region 10 Project Number 18-0002-COE). The EPA is also supporting the Corps in development of specific sections of the EIS as a cooperating agency in accordance with the cooperating agency agreement. As a cooperating agency, we have participated in meetings and provided comments on early drafts of EIS material, including on sections of the Preliminary DEIS in December 2018. We also provided scoping comments to the Corps on June 29, 2018.

Project Background

The Pebble Limited Partnership (PLP) is proposing to develop the Pebble copper, gold, and molybdenum ore deposit in southwest Alaska. The Pebble deposit lies within the Nushagak and Kvichak watersheds, which together account for more than half of the land area in the Bristol Bay watershed.

The proposed project includes an open-pit mine, tailings storage facilities (TSFs), water management ponds, a mill facility, a natural gas-fired power plant, and other mine site facilities. Approximately 1.3 billion tons of ore would be processed at a rate of 180,000 tons of ore per day, over the proposed mine operating life of 20 years. The initial surface disturbance footprint is approximately 8,086 acres and the 608-acre pit would have a maximum pit depth of 1,970 feet. Potentially acid generating (PAG) tailings and non-PAG bulk tailings would be disposed in two tailings facilities that would cover a total of approximately 3,867 acres. Water discharges from the pit lake following mine closure would require water treatment in perpetuity.

The proposed project also includes development of a 188-mile natural gas pipeline across Cook Inlet and Lake Iliamna and two compressor stations used to transport natural gas from the Kenai Peninsula to the mine site. The proposed transportation network would include construction of: 77 miles of new roads, including mine and port access roads and spur roads to communities; ferry terminals on the north and south shores of Lake Iliamna for use by an ice-breaking ferry; and the Amakdedori Port on Cook Inlet.

In addition to the no action alternative and the proposed action (Alternative 1), the DEIS analyzes two additional alternatives and includes variants to the alternatives.

Overview of Comments and Recommendations

We appreciate the progress that the Corps has made and the improvement to the analysis resulting from engagement with the EPA early in the NEPA process. However, the DEIS appears to lack certain critical information about the proposed project and mitigation, and there may be aspects of the environmental modeling and impact analysis which would benefit from being corrected, strengthened, or revised. Because of this, the DEIS likely underestimates impacts and risks to groundwater and surface water flows, water quality, wetlands, aquatic resources, and air quality from the Pebble Project. Inclusion of the additional information and analyses we have identified, or further explanation in the EIS of these issues, is essential to more fully evaluate and disclose the potential project impacts and identify practicable measures to mitigate those impacts. The EPA is committed to working with the Corps to provide our expertise where it can be of assistance.

Our priority comments and recommendations are summarized below. We have enclosed detailed comments explaining these priority comments and recommendations. Our detailed comments also address other issues identified in the EPA's review of the DEIS, including geohazards, environmental justice, and subsistence.

Project Description and Mitigation Details
The DEIS and supporting reference information acknowledge that key aspects of the Pebble Project are at a conceptual level (i.e., early or initial stage) of design and development. Critical but conceptually developed project components include: the open pit mine dewatering system; the dams retaining the mine's tailings and main water management pond; the collection, pumpback, and monitoring systems for managing seepage from the TSFs and main water management pond; and the closure water treatment plant. Critical plans that are yet to be developed or are only conceptually described in the DEIS include plans for: mine reclamation and closure; environmental monitoring; adaptive management; tailings and waste rock characterization and management; fugitive dust control; and strategic timing of water discharges.

More detailed versions of these project components and plans, however, are critical to the evaluation of environmental impacts, alternatives and mitigation. Without more detail, many of the predictions associated with these components and plans in the DEIS do not appear to be fully supported based on the current level of documentation. Given the scale of the project and importance of the aquatic resources in the Bristol Bay watershed, we recommend including more developed designs and plans in the EIS to provide a level of detail that will allow for more meaningful disclosure of the project's potential impacts and the effectiveness of its pollution control infrastructure and plans that are important for environmental protection and mitigation.

Range of Alternatives
The DEIS predicts that groundwater contamination would occur under the bulk TSF. We therefore recommend that the EIS include as an alternative, variant, or mitigation measure the use of a liner under the bulk TSF (with appropriate overdrains to ensure stability). In addition, we recommend that the EIS discuss in detail an alternative or variant that includes the infrastructure elements that would be anticipated under the Pebble Mine Expanded Development Scenario (i.e., diesel pipeline, port site at Iniskin Bay). This would enable consideration of options that would avoid or minimize cumulative impacts that would occur as result of redundant infrastructure associated with expanded development. The EPA recommends that these alternatives or variants be further analyzed in the NEPA analysis as they may be components for the least environmentally damaging practicable alternative (LEDPA) under

Section 404 of the Clean Water Act. We recommend that the alternatives analysis provide the information necessary to support an evaluation of alternatives under the Clean Water Act Section 404(b)(1) Guidelines, including information to support identification of the LEDPA. This issue is further discussed in the EPA's separate comments to the Corps on the Clean Water Act Section 404 Public Notice.

Alternative 3 includes a port site variant that would include a water treatment plant at the port to treat and discharge process wastewater from the concentrate pipeline to Cook Inlet. The discharge of process wastewater alone as defined under this variant likely is not allowed under the Clean Water Act and the National Pollutant Discharge Elimination System (NPDES) regulations (see 40 CFR 440 Subparts J and L). Therefore, we recommend that this variant be reconsidered.

Groundwater and Streamflow Impacts

The DEIS relies on watershed, groundwater, and water balance models to predict how mine site activities will change groundwater conditions and impact surface water and aquatic resources. The uncertainty analysis for the groundwater model, however, concludes that the model may significantly underpredict the amount of water produced during mine pit dewatering. The DEIS discloses that this could result in the groundwater zone of influence being larger than predicted and North Fork Koktuli, South Fork Koktuli, Upper Talarik Creek, and tributary stream flows being reduced to a greater extent than is currently predicted in the DEIS. Significant adverse impacts to wetlands and to streams with documented anadromous fish occurrence may result from such stream flow reductions. We recommend that the groundwater model be revised to reduce this uncertainty and provide more accurate predictions associated with open pit dewatering. We have additional recommendations to verify the water balance model and clarify how uncertainties associated with the watershed model effect EIS predictions. We recommend that the EIS fully analyze the potential adverse impacts to groundwater, wetlands, and streams with documented anadromous fish occurrence based on the results of the revised modeling.

Water Quality Impacts

The DEIS may substantially underpredict potentially significant impacts to water quality. Our key comments are:

- The DEIS provides inadequate support for several assumptions regarding the behavior of leachate and relies on very limited sample representativeness for prediction of acid rock drainage and metal leaching. This may result in unanticipated leaching of metals/metalloids at elevated concentrations;
- The DEIS lacks critical details regarding the design and operation of the water treatment plants, particularly at closure. The DEIS reference material states that there is insufficient available information to evaluate the effectiveness of the closure water treatment plant to meet water quality criteria. This prevents meaningful analysis and disclosure of potential water quality impacts related to water treatment;
- As a result of groundwater model uncertainty, the DEIS states that the water treatment plants may need to treat and discharge more mining process water than that for which the plants are currently designed. Significant impacts to water quality could occur if that is the case; and
- Use of conceptual drainage and seepage containment systems for the TSFs and water management pond do not fully support the DEIS assumption that 100% of the seepage would be captured.

The EPA also recommends that the EIS include a data quality assessment for background water quality data, a modeling sensitivity analysis of the water quality modeling and inputs, a reasonably complete analysis of water quality impacts in the closure and post-closure phases, and monitoring and adaptive management plans.

Wetlands Impacts and Compensatory Mitigation

The Pebble Project would result in the permanent loss of approximately 3,560 acres of jurisdictional wetlands and other aquatic resources, including 3,443 acres of wetlands, 55 acres of lakes and ponds, 81 miles (50 acres) of stream channels, and 11 acres of marine waters. An additional 510 acres of streams, wetlands, lakes, ponds, and marine waters would be temporarily filled for construction access, and 2,345 acres would experience secondary impacts due to groundwater drawdown (449 acres) and fugitive dust (1,896 acres). The DEIS, however, does not fully identify and characterize existing aquatic resources and wetland functions to establish the environmental baseline for an impact analysis and mitigation considerations because the analysis area is limited and salient available site-specific data is not utilized. In addition, the EPA recommends a more complete analysis of secondary/indirect effects, which is important to analyze project impacts and compare alternatives.

In terms of compensatory mitigation, the draft Compensatory Mitigation Plan includes only a conceptual discussion, notwithstanding the proposed project's substantial impacts to wetlands and aquatic resources. The plan also does not fully address the types of direct and indirect impacts to waters of the U.S. that may occur and does not identify specific mitigation projects. Therefore, the availability, practicability, and effectiveness of compensatory mitigation to offset unavoidable impacts is unsupported. To ensure disclosure of practicable means to mitigate the direct, indirect, and cumulative impacts of the Pebble Project, the EPA recommends the EIS include a reasonably detailed draft Compensatory Mitigation Plan. This recommendation is further discussed in the EPA's separate comments to the Corps on the CWA Section 404 Public Notice.

Impacts to Fish and Fish Habitat

The impacts on ecologically important streams, wetlands, lakes, and ponds and the fishery areas they support should be more fully addressed in the EIS. The EPA recommends significant improvements to: habitat characterization, assessment, quantification, and spatial referencing; assessment of linkages between the loss and/or degradation of habitat and impacts to fish species and life stages (i.e., incubating eggs, spawning fish, and rearing juveniles); groundwater and surface water flow characterization at a scale that is more relevant to fish and fish habitat; and analysis of the potential population-level effects and effects on genetic diversity in the context of the Bristol Bay salmon portfolio. We recommend that the analysis in the DEIS be revised to address these issues.

Air Quality Impacts

Priority issues associated with the air quality analysis include:

- Particulate matter impacts from the mine site may be underpredicted in the EIS based on the modeling parameters used to predict impacts from the mine pit; and
- Assumptions and potential errors in the air quality modeling assessment for the port facilities include lack of evaluation of substantial mobile emissions from vessel traffic, and differences in

meteorological conditions at the Diamond Point port site as compared to the Amakdedori port site.

Our detailed comments provide recommendations to strengthen the air quality analysis.

Tailings Containment and Spill Risk

The DEIS does not fully characterize the stability and performance of the dams containing tailings and contact water in the event of an earthquake. A deformation analysis and seismic safety factor were determined for a past design of the bulk TSF, but this analysis was not provided for the current TSF dam design or for the other dams. The TSFs and main water management pond dams are significant structures that range in height up to 545 feet with combined lengths of 7.2 miles (for the TSF dams) and 3.6 miles (for the WMP dams). We recommend seismic safety factors and potential earthquake induced stability impacts be assessed for these dams so that the EIS discloses how the dams will be impacted by a potential earthquake.

The DEIS, based on conclusions of a Failure Modes Effects Analysis (FMEA), does not evaluate the potential release of tailings from the bulk TSF due to a dam breach or failure. The FMEA risk register, referenced in the DEIS, identifies a number of adverse factors that could occur during engineering, construction, and operations, but assumes that all of these challenges would be overcome. Support for this determination is limited given the simplified conceptual dam designs, lack of operational, monitoring, and closure plans and lack of representative seismic analysis for the bulk TSF. We recommend that a bulk TSF breach or failure scenario be developed, and potential impacts be evaluated and disclosed.

In addition, the spill risk analysis for concentrate and tailings warrants improvement. The current analysis may underpredict impacts of spills due to assumptions and incomplete information related to the role of oxygen in aquatic environments, timing for release of mineral components, and reactivity in porewater. We recommend revising the analysis to address these issues, so that potential adverse impacts to water and sediment quality from leaching of metals are fully disclosed, as well as any associated impacts on fish populations.

Indirect Effects and Cumulative Impacts

The DEIS summarizes potential indirect effects and cumulative impacts in general terms, with limited quantitative analysis of large-scale additional impacts resulting from reasonably foreseeable future actions. We recommend a more robust evaluation of indirect impacts and cumulative effects, particularly in terms of the Pebble Mine Expanded Development Scenario.

Conclusion

The enclosure includes detailed discussion and specific recommendations regarding the key issues summarized above, as well as other issues identified in the EPA's review. Given the substantial potential impacts and risks of the proposed project and weaknesses in the DEIS, the DEIS likely underestimates adverse impacts to groundwater and surface water flows, water quality, wetlands, fish resources, and air quality. Therefore, conclusions that the project will not violate applicable water quality and air quality standards should be further supported. Our detailed comments include recommendations to provide

significant additional information about key project components and plans and improve the environmental modeling and other aspects of the impact assessment.[1]

We will continue to work constructively with the Corps as a cooperating agency, providing special expertise in specific areas requested by the Corps, including: alternatives; recreation; aesthetics and visual resources; soils; surface- and groundwater hydrology; water and sediment quality; wetlands and special aquatic sites; vegetation; and mitigation. We also continue to request the ability to assist the Corps in additional areas of the Pebble Project EIS, including fisheries and air quality, where we have special expertise and jurisdiction. In addition, we recommend that resource-specific interagency technical workgroups be developed to work through significant issues. We look forward to working with you and the other cooperating agencies on the next steps in the NEPA process.

If you have questions concerning our comments, please contact Patty McGrath, Mining Advisor and lead for the Pebble Project NEPA/Permitting Team, at mcgrath.patricia@epa.gov or 206-553-6113, or Molly Vaughan, NEPA Reviewer, at vaughan.molly@epa.gov or 907-271-1215.

Sincerely,

Chris Hladick
Regional Administrator

Enclosure: U.S. Environmental Protection Agency Detailed Comments for the Pebble Project Draft Environmental Impact Statement

cc: Colonel Phillip Borders, USACE Alaska District

[1] Effective October 22, 2018, the EPA no longer includes ratings in our comment letters. Information about this change is explained in the Memorandum on Changes to EPA's Environmental Review Rating Process, available at https://www.epa.gov/nepa/policy-and-procedures-review-federal-actions-impacting-environment-under-section-309-clean-air.

EPA Region 10 Detailed Comments for the
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EPA Region 10 Detailed Comments for the
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We have reviewed the DEIS and provide detailed comments and recommendations below for improved information and analyses to strengthen disclosure of the impacts of the project and alternatives and potential mitigation measures. This enclosure provides discussion of the key issues summarized in the cover letter to which these comments are attached and also includes additional comments and recommendations.

These comments are organized in the following major sections:
1. Description of the Proposed Project;
2. Alternatives;
3. Comments on specific resource sections of the EIS, including Groundwater and Surface Water Hydrology, Water Quality, Wetlands and Other Waters/Special Aquatic Sites, Fish Values, Commercial and Recreational Fisheries, Geohazards, Air Quality, Environmental Justice, Subsistence;
4. Spill Risk;
5. Indirect and Cumulative Impacts, including the impacts of the Pebble Mine Expanded Development Scenario;
6. Mitigation and monitoring, including compensatory mitigation; and
7. Availability and use of data, including data gaps and data quality.

These comments are generally organized following the structure of the DEIS: project description and alternatives, resource-specific sections, spill risk, and mitigation. For efficiency, we grouped like comments associated with conceptual project features and plans, indirect and cumulative impacts, and availability and use of data. Comments on specific resource sections are ordered by, first, those areas where the Corps has requested our special expertise (hydrology, water quality, wetlands) followed by the other resources areas where we have comments and recommendations (fish, geohazards, air quality, environmental justice, and subsistence). A summary paragraph at the beginning of each of the major sections lists the most significant issues that are discussed further in the section. Additional detailed comments are provided following the discussion of the key issues in each of the major sections, as well as EPA's recommendations. EPA encourages the Corps to further explain why its analysis in the DEIS is sufficient if the Corps, after consideration, disagrees with some or all of the recommendation.

Description of the Proposed Project

A priority issue related to the description of the Pebble Project is the conceptual (early or initial stage) of design and development of aspects of the Pebble Project that are important to environmental protection. We recommend that the following key project features and plans be further developed to support the assessment of impacts to groundwater and surface water flows, water quality, streams, wetlands, lakes, and ponds and the fishery areas they support; and impacts to air quality:
- Open pit dewatering system;
- Waste rock characterization and management plan;

- Seepage water management system associated with TSFs and water management ponds (WMPs);
- Tailings storage facility (TSF) and main WMP embankment designs and plans;
- Closure water treatment plant;
- Plan for strategic timing of water discharges;
- Reclamation and closure plan;
- Financial assurance cost estimate;
- Monitoring plan;
- Adaptive management plans; and,
- Fugitive dust control plan.

We recommend that Pebble Limited Partnership (PLP) consider developing the Project Description into a more detailed draft plan of operations that includes a tailings and waste management plan, reclamation and closure plan, monitoring plan, and updated water management plan. These plans are typically supplied or required as a basis for development of state of Alaska permit applications and provide more detailed information that is frequently used in the analysis of the impacts of large mining projects in Alaska under NEPA. The development of these plans may efficiently help address several areas where the EPA recommends further information be provided to support the EIS.

Our recommendations regarding these key issues are described below followed by additional comments and recommendations for improvement related to the project description.

Conceptual Level of Design of Key Project Features and Plans

Open Pit Dewatering System: The DEIS states that the pit dewatering design has not been developed (pg 2-16) and that the conceptualized plan for pit dewatering consists of approximately 30 wells (pg. 4.17-3). The extent of the groundwater cone of depression and changes to groundwater and surface water hydrology are dependent upon the pit dewatering system design. We recommend that the pit dewatering system design be developed to provide a basis for the impact assessment, to provide more certainty to the assessment of pit dewatering impacts to groundwater and surface water, including alterations to streamflow. As one component of the design, we recommend clarifying whether the well array will include the entire vertical expanse of the aquifer(s) relevant to the depth of the adjacent pit, to ensure that an inward gradient of groundwater flow with depth is achieved. If more detailed design information is not developed, then we recommend that the EIS summarize the uncertainty associated with the conceptual design and how future design changes could impact groundwater hydrology predictions associated with pit dewatering.

Waste Rock Characterization and Management: The DEIS provides general statements about how PAG/ML (Potentially Acid Generating/ Metal Leaching) and NPAG/non-ML wastes would be managed. We recommend the inclusion of the following additional information, which is typically included in mining EISs, to provide a more specific basis for evaluating the effectiveness of waste management procedures and subsequent environmental impacts to water quality due to acid rock drainage and metals leaching. This information could be provided in a waste management plan as is frequently done for large mining projects in Alaska (see also our comments on Water Quality regarding this information).

1. The specific criteria that would be used to separate PAG from NPAG rock are not described in Chapter 2. Section 4.18 discusses an NP/AP ratio of 1.4, but it is not clear if that is the ratio that

would be used in practice, since it does not appear in the Project Description and a waste management plan has not been developed. We recommend that the DEIS provide the criteria that would be used to separate PAG from NPAG waste.

2. The statement on page 2-16 that, "PAG and ML waste rock would be stored in the pyritic TSF until mine closure" implies that there are two different kinds of rock – PAG rock and ML rock. We recommend that the EIS provide the definition of ML waste rock to support statements made in this Chapter and the Project Description (Appendix N).
3. In addition to identifying the criteria or thresholds that would be used to distinguish PAG from NPAG rock and ML from non-ML rock, we recommend that the EIS include the specific procedures that would be used to separate these materials. Some examples of general procedures are currently provided, such as visual inspection, blast hole sampling, and bench mapping, however, additional detail on the actual procedures would improve support for conclusions regarding potential impacts to water quality.
4. Chapter 2 discusses the segregation of waste rock and overburden and that "NPAG and non-ML waste rock <u>could be</u> used for embankment construction." On page 4.18-10 the DEIS discusses that some PAG rock <u>would be</u> used at "limited locations" on the northern embankment of the pyritic TSF. We recommend that the EIS clarify these conflicting statements regarding the use of NPAG and non-ML waste rock and PAG waste rock for construction. We recommend that the EIS discuss how the non-acid generating and non-metals leaching material would be determined, where this waste rock will be stored, and how runoff would be managed, if the materials are not used for construction. In addition, we recommend that PAG waste rock not be used for embankment construction due to the possibility of leaching that could impact stability or result in contamination.

<u>TSF and Water Management Pond Seepage Management</u>: The DEIS in Chapter 2 and Section 4.18 provides general descriptions of the seepage management systems and assumes that 100 percent of the seepage from these project features would be captured. We recommend that the EIS include additional information describing the seepage management and collection systems for the Bulk TSF, pyritic TSF, and water management ponds in order to provide a basis for seepage capture estimates and more accurately evaluate impacts.

In regard to the Bulk TSF, the DEIS states that, "[t]he underdrains would enhance the flow-through design concept by providing a preferable seepage path from the tailings mass to the [seepage collection pond (SCP)] downstream of the embankment toe… [D]etails of the underdrains would be developed following more detailed site-specific geotechnical and geological investigations and observations made during the preliminary and detailed designs, in accordance with the ADSP guidelines." (pg. 2-22). Without a preliminary design of the underdrain and seepage collection system included for review in the EIS, we were not able to verify that "[a]ll bulk TSF contact water that seeps through the embankment would be hydraulically contained," (pg 2-24) and that groundwater contaminated by seepage that bypasses the capture system would further be detected by the seepage pumpback monitoring wells at "potential" well locations (Section 4.18.3.1). The DEIS also states that additional seepage collection, cutoff walls, and/or pumpback systems may be installed downgradient, if necessary, as determined by monitored water quality, but locations and design information for these features and a monitoring plan is not currently provided.

The EPA recommends that the Corps provide further detail to support the seepage capture efficiencies for the Pyritic TSF and water management ponds. Liners are currently proposed only under the pyritic TSF and water management ponds. The DEIS states that, "[l]iner materials would be selected during the preliminary and detailed designs in accordance with the [Alaska Dam Safety Program (ADSP)] guidelines…" (pg. 2-21). Liners are an essential component of the seepage management approach and liner characteristics influence predictions made about groundwater quality. We recommend that the EIS include additional information about liner materials and design to support EIS impact predictions that rely upon liner efficiencies.

We recommend that the EIS provide the following information related to seepage management for the TSFs and water management ponds: specific location of the underdrains in relation to project features and seepage and groundwater flow paths; performance criteria and capacity of the underdrain systems; for facilities with liners, specific types of liner and performance criteria; number of groundwater monitoring and pumpback wells and their actual locations and depths in relation to groundwater flow paths; monitoring that would occur to determine if pumpback systems are implemented; analysis of these seepage management design features in relation to Pebble Project features, and; predicted extent of groundwater contamination.

We recommend this level of detail because it supports evaluation of the effectiveness of seepage control, supports seepage rate estimates in groundwater modeling, and assists in determining environmental impacts. If specific detailed seepage collection and pumpback system design is not included in the EIS, we recommend that the EIS further evaluate the efficiency of existing systems in similar environments, to either support and demonstrate that 100 percent capture is possible or any alternative seepage capture efficiencies indicated by that evaluation.

<u>TSF and Main Water Management Pond Embankment Design and Plans</u>: According to Section 4.15 (Geohazards) and DEIS reference materials, the designs of the tailings and water management embankments are early stage and conceptual. We recommend using a more detailed level of design in order to evaluate with more specificity stability and impacts to environmental resources from significant mining structures, such as the TSF and WMP embankments. This is particularly important since the design of the tailings dams was identified as a significant issue during scoping (per Appendix A of the DEIS, tailings dam design ranked in the top five key issues). We recommend that preliminary designs be provided for all the embankments, as they serve as the basis for the impact assessment. See our comments on Section 4.15 for more details.

The DEIS identifies plans that will be developed for the TSFs during the ADSP permitting process including the Operations & Maintenance Manual, Emergency Action Plan, and monitoring (pg. 2-28). We recommend that the main elements of the emergency action plan and monitoring plan be described in more detail so that responsive actions in the event of changes in embankment performance (stability, seepage), accidents, or failures are further explained and effectiveness of these actions at reducing impacts can be better understood.

<u>Pyritic TSF and Tailings Deposition</u>: Page 2-26 states that "[t]he PAG waste would be placed on the geomembrane cover layer around the perimeter of the TSF before the tailings would be placed, and the PAG waste would be covered by the pyritic tailings. The entire pyritic TSF would be continually inundated with water to prevent the tailings and PAG waste from oxidizing and generating ARD." We recommend replacing the word "prevent" with "minimize the likelihood," or alternatively, adding discussion of how complete anoxic conditions would be created and maintained. Further, page 2-28

states that "[t]he surface level of the tailings would be maintained below the level of the PAG waste rock bench so that the tailings would always be buffered from the embankments by the PAG waste rock. The pyritic tailings would be kept submerged to prevent oxidation and potential acid generation." These two pages contain conflicting information. We recommend that the EIS clarify these points and describe why the PAG waste around the perimeter would be covered by tailings if the desire is for the tailings to be away from the perimeter to allow water to pool over the tailings without being too close to the embankments, causing risk of embankment failure. Additionally, we recommend that the EIS describe whether the tailings are going to be maintained at a surface level below the PAG waste rock bench, since then the PAG waste rock would not be inundated with water. It also seems that embankment stability would be impacted if water is intended to cover the PAG rock as well as the tailings. Further, if the PAG waste rock is not inundated and therefore anoxic, it will be exposed to the atmosphere, and the resultant acidity and metals from the oxidation of minerals in the PAG rock would runoff with precipitation into the water overlying the tailings. We recommend that the waste rock and tailings management aspects be clarified in an updated project description or waste management plan and that the EIS further clarify both PAG waste and pyritic tailings placement and method for minimization of oxidation of both wastes.

Closure/Post-Closure Water Treatment: Based on our review of Section 4.18, K4.18, and referenced documents, we recommend that the Corps provide additional information to evaluate whether the proposed closure/post-closure water treatment process (WTP #3) would be able to treat water from the open pit to meet applicable water quality standards. In addition, there are significant uncertainties associated with the design of the operations main water treatment plant (WTP #2) due to the potential for the buildup of salts and selenium. We recommend that additional evaluation of water treatment occur as recommended in AECOM's independent review of the WTPs (AECOM 2018i) and that the water management plans be revised to reflect water treatment designs and processes that will treat operations and closure/post-closure water discharges to meet the state standards. Section 4.18 and Appendix K4.18 of the DEIS do not definitively conclude that the closure WTP will meet standards; instead the DEIS states that "water quality of discharge from the open pit WTP is the subject of ongoing engineering analysis" (pg. 4.18-52). See our comments on Water Treatment, below, related to this issue for more information.

Reclamation and Closure: The lack of a detailed reclamation and closure plan is identified as a data gap in Section 3.1 of the DEIS. Reclamation and closure plans are frequently provided in mining EISs and we recommend that a reclamation and closure plan with a reasonable level of detail be provided to support the Pebble Project EIS analysis as this information is important to determine the effectiveness of reclamation and closure actions and resulting environmental impacts. The DEIS states that to accomplish dry closure, the bulk TSF tailings surface "would be covered with soil and/or rock and possibly a geomembrane or other synthetic material" (pg. 2-39). RFI 091 presents advantages and disadvantages of these cover types although it does not state what cover type would be used. We recommend that the EIS describe what specific cover material would be used to close the bulk TSF so that the effectiveness and timing of achieving dry closure can be better determined. Regarding the pyritic TSF, we recommend that the reclamation and closure plan and the EIS more fully assess the ability to adequately remove the pyritic tailings, PAG waste, liner, and any contaminated soil underneath. Further we recommend that the reclamation and closure plan describe plans for restoring any streams, wetlands, and ponds. In addition, we recommend that the EIS describe with more specificity how the cited State of Alaska reclamation standards would be implemented and met.

Financial Assurance: The DEIS states that "[a] detailed reclamation and closure cost model would be developed to address all costs required for both the physical closure of the project, and the funding of

long-term post-closure monitoring, water treatment, and site maintenance" (pg. 2-41). We recommend a more specific discussion of the estimated financial assurance amount and mechanism be provided, given that long term water management and treatment would be required in accordance with State of Alaska regulations. This would provide a basis for evaluating whether the reclamation and closure activities would be effective in the event of a bankruptcy or compliance issues. Our scoping comments (pg. 24) provided recommendations on the level of information to include in the financial assurance estimate. Other mining EISs developed by the Corps that that may serve as models for developing financial assurance estimates include the Donlin Gold, Haile Gold, and Northmet Mine EISs.

Plan for Strategic Timing of Water Treatment Plant Discharge: There are statements in the DEIS that the treated water discharges will be managed to optimize downstream fish and aquatic habitats (pg. 4.18-7 and elsewhere). However, the DEIS does not specify how the discharges would "optimize downstream habitat." We recommend adding a discussion and details of the strategy and how effectively it will mitigate project impacts to stream flow, water quality, and fish. We also recommend discussing how the water will be discharged or whether or where water would be stored in the interim between being treated and being discharged to accomplish strategic timing.

Fugitive Dust Control Plan: The project relies on a Fugitive Dust Control Plan to control and mitigate impacts from fugitive dust generated by the project. The DEIS provides examples of control measures that might be included in the fugitive dust control plan but does not provide the plan itself, nor does it state whether the example control measures represent project commitments. We recommend that a draft fugitive dust control plan be included in the EIS that specifies the control measures that would be used in order to more fully explain the extent to which fugitive dust releases would be mitigated and therefore reduce uncertainty regarding the level of potentially significant environmental and human health impacts due to dust releases. Our comments below on Mitigation provide a list of elements that we recommend be included in the Fugitive Dust Control Plan.

Monitoring Plan: The DEIS states that PLP proposes to use monitoring measures through construction, operations, and closure of the proposed project to assess predicted impacts and effectiveness of mitigation and that the monitoring plans would be developed during state permitting. Monitoring plans are typically included or referenced in mining EISs. We recommend that a monitoring plan with a reasonable level of detail be developed for the EIS to better provide a basis for the Corps conclusion that the monitoring plan would be effective at detecting changes. We recommend that the monitoring plan specify resources and locations that would be monitored, monitoring frequencies and parameters, and discussion of how monitoring results would be compared to baseline conditions and trends to determine if project impacts are different than predicted.

Adaptive Management Plan: Adaptive management plans are mentioned in the hydrology, water quality, and fish sections of the DEIS as an approach to respond to site conditions and project impacts that are different than predicted. The DEIS identifies that adaptive management could occur as a result of excess site water, changes to water flows and chemistry, uncontrolled potential seepage from northwest ridge of the bulk TSF, salt and selenium buildup in the water treatment plants, and impacts to water and fish that are greater than predicted. The DEIS provides examples of adaptive management and contingency actions but does not include an adaptive management plan or describe whether these examples represent project commitments. We recommend that PLP develop an adaptive management plan(s) for these elements so that the effectiveness of adaptive management at identifying and responding to changes and mitigation impacts can be assessed in the EIS. We recommend that the adaptive management plan describes which project elements would be subject to adaptive management and, for each of these

project elements, identifies the specific monitoring that would occur, thresholds or trigger levels that would result in an adaptive management or contingent actions, and the specific actions that would be taken in the event of the threshold or trigger level being exceeded.

Additional Comments on the Proposed Project

Following are additional comments related to the description of the Proposed Project.

Mine Site Material Sources: The DEIS states that surface runoff from the quarries for mine site material is non-contact water (pg. 2-18). Quarries are classified as gravel pits and subject to the CWA National Pollutant Discharge Elimination System (NPDES) Effluent Limitation Guidelines (ELGs)[1] and any surface runoff is defined as mine drainage. This type of discharge could be covered by an Alaska Pollutant Discharge Elimination System (APDES) general stormwater permit because this is one of the non-stormwater discharges that can be covered. We recommend that the characterization of this type of water be corrected.

Material Management and Supply: Chapter 2 of the DEIS states that "Appendix K2 provides a table that shows average annual quantities of fuel, mining, milling, and miscellaneous consumables, as well as common mining supplies, processing reagents, and materials" (pg. 2-30). Table K2-5 does not include the chemicals required for the water treatment plants during operations and closure. We recommend that the chemicals and estimated quantities that would be required for water treatment be added to Table K2-5 so that both the type and amount of chemicals are included. In addition, since large quantities of specific chemicals would be required, we recommend ensuring that both traffic estimates for materials being brought to the site and onsite storage requirements during operations and closure include the chemicals needed for ongoing water treatment.

Transportation Corridor, Ferry: Regarding bilge water, which would be treated and discharged to Lake Iliamna, the Vessel Incidental Discharge Act (VIDA) requires the EPA to develop performance standards for those discharges and requires the U.S. Coast Guard to develop implementation, compliance, and enforcement regulations. Under VIDA, all provisions of the EPA NPDES Vessel General Permit (VGP) remain in force and effect until the U.S. Coast Guard regulations are finalized. We recommend that Chapter 2 of the EIS be updated to acknowledge the existing and future regulatory requirements for discharges from vessels, such as the ferry across Lake Iliamna. The DEIS also states that there will be office and maintenance buildings at both terminals (pg. 2-50), and we recommend that this section include a description of wastewater disposal for the terminal buildings.

Port Operations and Materials Transport: The DEIS describes the potential for wash water from rinsing the mine/ore concentrate containers to be treated and discharged at the port site (pg. 2-69). This water is mine process water, and as such, it is not an allowable discharge under the CWA. See our additional comments under Alternative 3, below.

Natural Gas Pipeline: The DEIS discusses that "mainline sectionalizing valves would be installed as required by code, with a spacing of no more than 20 miles for the onshore sections" of the natural gas pipeline (pg. 2-75). We recommend that the spacing for off-shore sections also be included.

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[1] 40 CFR § 436.

Summary of Project Phases: Table K2-2 (Appendix K2) summarizes the activities that would occur during the project phases. During the closure and post-closure phases, the activity is listed as "Closure" and "Monitoring." We recommend that the need for active long-term water management and treatment be included during each of these project phases, including a specific description of the activities during the closure and post-closure phases.

ALTERNATIVES

Our primary issue and recommendation related to alternatives is that the EIS analyze additional alternatives so that the EIS range of alternatives includes alternatives that may be the Least Environmentally Damaging Practicable Alternative (LEDPA) under Section 404 of the CWA. Our letter on the CWA 404 Public Notice (see Section VI of the letter) also reflects these issues and discusses the CWA 404(b)(1) Guidelines.

Alternative 3 – Concentrate Pipeline Variant: Alternative 3 includes a port site variant that would include a water treatment plant at the port to treat and discharge process wastewater from the concentrate pipeline. That wastewater would consist solely of process wastewater resulting from use of a froth floatation process in the mill. Discharge of that process wastewater is prohibited under the New Source Performance Standards (NSPS) of the Effluent Limitation Guidelines (ELG) which were promulgated under the Clean Water Act by the EPA in 1982 (see 40 CFR 440.104(b)(1)). Discharge of process wastewater should not be included as a variant to an alternative in the EIS because this discharge is not feasible as that term is used under in NEPA (i.e., it cannot be authorized in an NPDES permit).

The New Source Performance Standards (NSPS) found in 40 CFR § 440 Subpart J cover three different types of discharges. Mine drainage and excess precipitation falling on the treatment area are allowable discharges under 40 CFR 440.104(a) while process water is not.

40 CFR 440.104(b), states:

> (b)(1) Except as provided in paragraph (b) of this section, there shall be no discharge of process wastewater to navigable waters from mills that use the froth-flotation process alone, or in conjunction with other processes, for the beneficiation of copper, lead, zinc, gold, silver, or molybdenum ores or any combination of these ores. . . .

While there are exceptions in the regulation that would allow the discharge of excess precipitation or recycle water, these exceptions do not apply in the case of the treatment system at the port facility as the pipeline would solely transport process wastewater. The exceptions stated in the 1982 NSPS are as follows:

> (b)(2)(i) In the event that the annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility exceeds the annual evaporation, a volume of water equal to the difference between annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility and annual evaporation may be discharged subject to the limitations set forth in paragraph (a) of this section.

> (b)(2)(ii) In the event there is a buildup of contaminants in the recycle water which significantly interferes with the ore recovery process and this interference cannot be eliminated through appropriate treatment of the recycle water, the permitting authority may allow a discharge of process wastewater in an amount necessary to correct the interference problem after installation of appropriate treatment. This discharge shall be subject to the limitations of paragraph (a) of this section. The facility shall have the burden of demonstrating to the permitting authority that the discharge is necessary to eliminate interference in the ore recovery process and that the interference could not be eliminated through appropriate treatment of the recycle water.

The language of the net precipitation allowance may lead one to the conclusion that any volume of water equivalent to the net precipitation could be discharged, regardless of water composition. The language of 40 CFR 440 Subpart L explains the concept of combined waste streams, which allows for discharge if allowable and nonallowable waste streams are treated together or stored together (as in a tailings impoundment facility):

> *"Combined waste streams.* In the event that waste streams from various subparts or segments of subparts in part 440 are combined for treatment and discharge, the quantity and concentration of each pollutant or pollutant property in the combined discharge that is subject to effluent limitations shall not exceed the quantity and concentration of each pollutant or pollutant property that could have been discharged had each waste stream been treated separately. In addition, the discharge flow from the combined discharge shall not exceed the volume that could have been discharged had each waste stream been treated separately." 40 CFR 440.131(a).

Further, the EPA wishes to correct a misunderstanding stated in the following discussion in the RFI 066:

> From RFI-066: "EPA's regulations do not limit where allowable discharges of process wastewater may occur nor do they restrict the process wastewater to certain processes within the mill or limit process wastewater discharges to those directly from the tailings facility. Rather, EPA's regulations only limit the total volume of process wastewater that may be discharged and leave open questions of "when, where, and how." As provided in EPA's 1982 Guidance document describing application of the net precipitation exception "[t]he volume allowed to be discharge[d] may be apportioned as the operator sees fit." See Development Document for Final Effluent Limitations Guidelines and New Source Performance Standards for the Ore Mining and Dressing Point Source Category, pp. 536 (EPA November 1982). This suggests that the mine operator has significant discretion on discharges of the process wastewater provided the operator does not exceed the volumes allowable under the regulations."

The above quote on apportioning the discharge is from a section of the Development Document that was part of the record for the ELGs discussing the discharge of net precipitation, not process discharges. As stated at 40 CFR 440.104(b), there shall be no discharge of process wastewater to navigable waters from mills that use the froth floatation process alone or in conjunction with other processes. The examples provided in the Development Document discuss the timing of the discharge of excess precipitation (more in wetter months, less in drier) and not the overall composition of the discharge. That analysis found in the Development Document does not address the commingling provisions of the NPDES regulations.

<u>Alternatives 2 and 3 – Transportation and Port Site</u>: Alternatives 2 and 3 include a port at Diamond Point, which is currently being developed as a rock quarry. Development of the Diamond Point rock

quarry involves construction of an access road, breakwater, barge landing, and a solid-fill dock. It also involves 11.42 acres of intertidal fill and dredging in Iliamna Bay. The DEIS does not consider the Diamond Point alternative in light of this rock quarry. Specifically, the DEIS does not explain whether and how the rock quarry and Diamond Point alternative will cause impacts to the same aquatic resources. The DEIS would be strengthened by a discussion of whether and how the dredging for the rock quarry would reduce the 58 acres of dredging and 16 acres of onshore dredge materials storage proposed for Alternatives 2 and 3. In addition, the DEIS does not consider whether and how the two projects will be integrated, if it all. We recommend that the DEIS address this in order to more fully explain whether there is a practicable alternative to the Diamond Port alternative that would have less adverse impact on the aquatic ecosystem. We recommend that the EIS document whether and how the rock quarry and proposed Diamond Point port infrastructure, dredging, and vessel operations will cause impacts to the same aquatic resources. In addition, we recommend that the EIS explain whether and how the two projects will be integrated, if at all. In the alternative, we recommend that the EIS further explain why its existing description of the alternatives analysis for the Diamond Port alternative is sufficient.

Mine Site Component Locations: The DEIS evaluates one location for each of the TSFs, both of which involve a discharge to wetlands or other special aquatic sites. TSFs are not water dependent, and as a result, practicable alternatives that do not involve a discharge to wetlands and other special aquatic sites "are presumed to be available, unless clearly demonstrated otherwise." DEIS Appendix B (TSF-025, pg B-80) indicates that the Corps considered 26 different locations for the TSFs that were not evaluated as alternatives. The DEIS identifies the location of three of these 26 options in Figure B-3 and the locations of the other 23 options are found in RFI 098. RFI 098 identifies TSF location options assessed by PLP that have less impacts to streams with anadromous fish than the proposed action. The DEIS does not fully explain why these 26 options are not practicable. To strengthen the TSF location options screening, we recommend that the Corps should include all 26 TSF options on Figure B-3 and explain why each of the 26 TSF locations are not practicable. Alternatively, we recommend that the Corps further explain why its existing description and analysis of the 26 TSF options is sufficient.

The location proposed for the main WMP involves a discharge to wetlands or other aquatic sites. WMPs are not water dependent, and as a result, practicable alternatives that do not involve a discharge to wetlands and other special aquatic sites "are presumed to be available, unless clearly demonstrated otherwise." The options screening analysis in DEIS Appendix B does not appear to consider any alternative locations for the main WMP. The DEIS does not explain why the main WMP location is the only practicable alternative or explain how the WMP location was optimized to avoid and minimize impacts to aquatic resources. We recommend that the EIS describe why the proposed location for the main WMP is the only practicable alternative and explain the extent to which the proposed WMP location was optimized to avoid and minimize impacts to aquatic resources. In the alternative, EPA recommends that the Corps further explain why its existing description of the main WMP is sufficient.

According to RFI 098, the 26 TSF layouts were compared to several attributes, including minimizing managed water volume, impacts to fish-bearing streams, and impacts to wetlands and stream miles. None of the attributes consider downstream impacts in the event of a tailings dam failure. In light of the value of fisheries resources in the potentially affected watersheds (see Section II), downstream impacts in the event of a tailings dam failure should be one of the attributes included in the comparison. EPA notes that the current best practice for evaluating the different tradeoffs between TSF location, dam type, and impacts is a Multiple Accounts Analysis (MAA). We recommend that the EIS evaluate and document the potential downstream impacts in the event of a tailings dam failure to support its LEDPA

determination and conclusions that there are not alternate location(s) that would have less impacts in the event of a tailings dam failure. We recommend that the EIS explain whether a MAA was performed for the TSFs or further explain why its existing description of the alternatives analysis for the TSFs is sufficient.

Transportation Alternatives – Corridors: The DEIS presents alternatives for the proposed transportation corridor, each of which involves discharges to wetlands and other special aquatic sites. The road and pipeline alignments are not water dependent, and as a result, practicable alternatives that do not involve the discharge to wetlands and other special aquatic sites "are presumed to be available, unless clearly demonstrated otherwise." We recommend that the DEIS more fully explain the information it considered when selecting which alternative road alignments to evaluate and in particular how this information relates to impacts on the aquatic ecosystem. In addition, the figures presented in K4.22 only provide information on wetlands and other aquatic resources inside the proposed corridors and do not indicate the status of areas outside the corridors. We recommend that the EIS explain and document the information it considered for the transportation corridor alternatives to demonstrate that there are not practicable alternatives to the transportation corridors analyzed that would have less adverse impact on the aquatic ecosystem, in order to clarify whether impacts to aquatic resources in the proposed transportation corridors could have been avoided and minimized. In addition, we recommend that the EIS include information about how wetlands and other aquatic resources were avoided and minimized to the extent practicable or further explain why its existing description of the alternatives analysis for the transportation corridor is sufficient.

Bulk TSF Liner: The DEIS predicts that groundwater contamination will occur under and beyond the bulk TSF. The DEIS assumes that all contaminated groundwater will be collected by the seepage management system. However, this assumption could be further supported with information about the seepage collection system design in relation to groundwater and geologic characteristics and the predicted contaminant plume (see our comments above and on Section 4.17). We have had discussions with the Corps about the considerations and trade-offs involved with inclusion of a liner. The EPA's letter on the CWA 404 Public Notice explains why the EPA believes this alternative could be part of the LEDPA. A liner is a typical management practice for TSFs that minimizes groundwater contamination, and we note that the Corps has recently permitted two fully lined tailings facilities at the Donlin and Haile mines and that a liner is included for the pyritic TSF. We recommend that the EIS evaluate the use of a liner as an alternative, alternative variant, or mitigation or further explain why a liner is not a practicable alternative to mitigate the predicted groundwater contamination. If a liner alternative or variant is analyzed, we recommend considering the inclusion of overdrains on top of the liner to help mitigate stability problems. Pumping tailings supernatant to the main WMP could be an additional mitigation measure to enhance stability, by further removing water from a lined tailings storage facility.

Potential Additional Alternative - Infrastructure Associated with Expanded Mine Development: The DEIS indicates that expanded surface mining would require construction of the north access road and concentrate pipeline as described in Action Alternative 3. However, the concentrate pipeline would terminate at a new deepwater port facility constructed in Iniskin Bay[2] rather than at Diamond Point. A diesel pipeline following the road route and a diesel terminal at the Iniskin Bay port would also be required (DEIS Table 4.1-2). The Iniskin Bay port and diesel pipeline are not, however, being evaluated as alternatives for the currently proposed project. These components may be practicable now and it is

[2] The project proponent previously evaluated Iniskin Bay as a potential port site and multiple years of baseline data were collected.

possible that they could be part of the LEDPA. In evaluating whether the Iniskin Bay Port and diesel pipeline are part of the LEDPA, the Corps must evaluate the direct, secondary/indirect, and cumulative impacts to jurisdictional waters resulting from each alternative considered. One potential advantage of the Iniskin Bay port and diesel pipeline is that constructing this infrastructure now may avoid redundant infrastructure for expanded surface mining. Specifically, when the cumulative impacts of expanded mine development are considered, infrastructure such as the southern access route and ferry would appear to be redundant and therefore involve avoidable impacts. The Council on Environmental Quality (CEQ) cumulative effects guidance (CEQ 1997) states that lead agencies can "[m]odify or add alternatives to avoid, minimize, or mitigate significant cumulative effects." The cumulative effects of an additional port site and pipeline to accommodate future mine expansion could be significant. We recommend that the EIS evaluate this additional transportation corridor alternative terminating in Iniskin Bay or further explain why it is not practicable.

GROUNDWATER AND SURFACE WATER HYDROLOGY

Priority issues related to groundwater and surface water hydrology include potential inaccuracies and uncertainties associated with the hydrologic modeling and conceptual level of pit dewatering design, seepage management system design, and adaptive management which may result in underpredictions of the magnitude and extent of impacts to groundwater and surface water hydrology. The following detailed comments describe these key issues and provide recommendations for additional analysis to fully explain potential impacts to hydrology; comments related to open pit dewatering, seepage management, and adaptive management are also found in "Conceptual Level of Design and Development of Key Project Features and Plans". Additional comments on groundwater and surface water hydrology are provided following our key comments.

Hydrologic Modeling

Verification of Water Balance Model: Section 3.16 states that the water balance model incorporates three modules (watershed, groundwater, and mine plan modules) and that "the watershed module is a semi-distributed spreadsheet-based precipitation-runoff model" (pg. 3.16-18). However, there is no detailed explanation of the model and its application included in the DEIS. Most applied models are reviewed for accuracy and validity by analyzing inputs, model components, equations of those component relationships, and comparison of model outputs with measured/observed data at different study watersheds. We recommend that the Corps provide documentation to address these important components of model application. We recommend that the Corps consider EPA guidance on evaluation, application, and reporting of environmental models for impact prediction,[3] and include further information regarding water balance model accuracy and validity and verification of the merits and limitations of the model. In addition, we recommend that the NEPA document include: a description of the input parameters, including which hydrologic cycle components are included in the model; what water balance equations are used to determine the relationships of different water balance components; whether the spreadsheet method of water balance approach has been tested at different watersheds for its applicability; and how calibration and validation years were determined.

Groundwater Model Calibration and Sensitivity Analysis: The DEIS states that the groundwater model is still in the process of being updated and has not been fully calibrated and that "[c]ompletion of a model calibration report demonstrating adequate calibration of the model and including a more robust

[3] Guidance Document on the Development, Evaluation, and Application of Environmental Models, EPA/100/K-09/003.

sensitivity analysis would enhance the reliability of the model findings" (pg. K4.17-2). Because groundwater model findings are essential to the evaluation of groundwater impacts and input into the water balance model, we recommend completing the groundwater model calibration and sensitivity report to better demonstrate the adequacy of the groundwater model and water balance model results used for the EIS analysis of impacts.

Appendix K3.17 states that Monte Carlo analysis was used to assess groundwater model uncertainty and that "[t]his methodology differs from standard sensitivity analyses in which model realizations frequently exceed calibration criteria, meaning that the scenarios simulated may not be physically credible compared to existing field data." (pg. K3.17-33). We recommend that the Corps further explain this discrepancy in methodology regarding the differences of the two methods (Monte Carlo vs. standard sensitivity analysis) in a quantifiable way, or further explain why quantification is not necessary in this regard. We also recommend that the groundwater model be revised to improve accuracy or that the EIS discuss how these potential inaccuracies with the model affect the impact predictions.

<u>Groundwater Model and Extent of Groundwater Hydrology Impacts</u>: The DEIS uses the groundwater model to predict changes in groundwater conditions resulting from mine site activities. The DEIS states that the model may underpredict the impacts of pit dewatering as "the range of capture zones shown on Figure 4.17-2 are based on evaluating a modest range of variability in hydrogeologic properties assigned to the different layers and zones in the model to estimate the effect of uncertainty in these parameters." Considering the model uncertainties, the actual results of dewatering the pit may differ from projections described above. The DEIS states that "[i]t is expected that the amount of water produced during pit dewatering could be larger than simulated, and the capture zone and zone of influence could be larger" (pg. 4.17-6).

We recommend revising the groundwater model to reduce this level of uncertainty and provide more accurate and conservative predictions relevant to the amount of water produced during pit dewatering, capture zone, zone of influence and changes in groundwater conditions. We recommend that the Corps evaluate the model's hydrogeological input parameters that have the most influence on groundwater model results and adjust these input parameters, as needed, to develop more accurate predictions of the capture zone and open pit dewatering amounts. We recommend that groundwater model results be provided for expected conditions and conditions that could occur during dry and wet years and that the EIS explain the range of conditions modeled.

The groundwater flow model results provide the basis for other estimates and models. Therefore, we recommend that impact analyses based on the groundwater flow model results be revised based on the revised groundwater modeling, including the water balance estimates and stream flow reduction estimates, in order to reduce the likelihood that the severity of effects on groundwater and surface water flows and the ecologically important wetlands, lakes, and ponds and the fishery areas they support be underpredicted.

<u>Watershed Module</u>: In the calibration and validation plots for the North Fork of the Koktuli River and the South Fork of the Koktuli River provided in RFI-104, the model underestimates streamflow during higher flows and overestimates streamflow during lower flows, but it doesn't appear that there is consistency within or between years. The differences are evident also for the Upper Talarik Creek sites but appear less dramatic. There is a statement in RFI-104 that the model may not be able to predict the lowest flows. Low streamflows are associated with groundwater base flow in systems where there is interaction between surface water and groundwater. Because it is important to ensure that the Watershed

Module and Water Balance Model calibration accounts for the seasonal and annual variability of streamflow to address low, average, and peak flow periods or dry, average, and wet years and because of the apparent differences in model predictability based on seasonal flows (peak months and baseflow months), we recommend considering running models for separate flow seasons to see if there were closer fits to the actual data that would more fully capture the seasonal and annual variability. Alternately, we recommend discussing in the EIS how the potential inability to predict the lowest streamflows influences interpretation and use of model results and groundwater and streamflow estimates. We also recommend discussing whether the use of seasonally-separated flow models would better predict actual conditions.

Discussion of the calibration in RFI-104, Watershed Model Documentation, states that, "[i]n general, modeled flows replicate the winter low flows and the peaks created by freshet and fall rains. The cumulative plots show that the total water passing the gage over the calibration period matches well; however, the model over predicts the cumulative volume of water over the first two years of the calibration period and under predicts the cumulative flow for the remaining 3 years for most gage sites. The maximum discrepancy between calculated and measured cumulative flows is up to about 20 percent across the sites." However, the plots in RFI-104 indicate that some of the absolute differences between measured and calculated streamflows differ by more than 20 percent. We recommend that the EIS discuss how the 20 percent discrepancy in cumulative flows is considered in the Watershed Model output and what influence those results have on the output of other modules, such as the Water Balance Module, utilizing the same data.

Watershed Model inputs are based on monthly averages. Extreme precipitation events can have significant impacts in the affected environment, which cannot be simulated using the month-to-month approach. We recommend consideration of modeling the maximum and minimum values, or following a daily or event-based approach, to capture the variability in conditions, or that the EIS demonstrate how the current approach represents the range of flows that occurs over each month and takes into account extreme events on the water balance components in the watershed. We recommend that the EIS discuss how variability in input data for the Watershed Module (and other modules) is accounted for in model output. This is especially important if outputs from one module are used as inputs to another module. If the uncertainty in the model output (from both the assumptions used to develop the model and from the variability in each component of input data) is not carried forward with any use of model outputs as inputs for another module, we recommend that the EIS describe how this practice affects the mine site water balance.

We also recommend that the EIS more fully explain how the baseline data set does or does not consider extreme climate conditions. Long-term historical hydrologic assessment helps to understand how the watersheds in the area respond to natural events, especially extreme events related to drought and flooding. The baseline surface hydrology data used in this analysis spans a period of approximately 10 years or less (primarily from 2004 to 2012). Because the data set does not appear to capture historical conditions, we recommend using models to assess historical conditions by incorporating modelled weather and climate parameters. We understand that synthetic precipitation and temperature records were developed as part of the analysis for the DEIS. We recommend that the EIS discuss how the synthetic weather variables were developed by describing the equations or methods used for development, the objective criteria to assess the synthetic variables, the uncertainty analysis used to evaluate the accuracy of synthetic products, and how the peak flows were estimated from those parameters.

Spatial variability of hydrologic components over the geographic area is notable, and we recommend that the modeling address this variability. Without accounting for spatial variability, it is difficult to conclude that the model applied is a semi-distributed model. We recommend that the EIS include whether any interpolation of weather parameters at gaging stations was conducted for the model to cover spatial variability of watersheds.

Finally, we recommend that the Corps further consider addressing the magnitude and extent of increase/or decrease of the surface water flow in streams within the project study boundaries and beyond. Quantifying the watershed's response as a system, rather than solely looking at changes at gaging points, can help to assess the environmental consequences. We recommend including predictions of possible consequences on surface water magnitude and timing from the full implementation of the mining project using different scenarios, for example minimum, average, and maximum impacts.

Hydrology Impacts

Bulk TSF Groundwater Hydrology Impacts at Closure: The DEIS (Section 4.17.3.1) discusses changes in groundwater hydrology due to the presence of the bulk TSF during operation, but not during closure and post-closure. The bulk TSF will remain as a permanent site feature at closure and post-closure and therefore we recommend that the EIS describe expected impacts to groundwater hydrology during these phases.

Bulk TSF Seepage Estimates and Environmental Consequences: The DEIS includes inconsistent statements regarding the amounts of bulk TSF seepage that would flow through the embankment and the amount of seepage that would flow vertically into bedrock fractures.

Regarding flow into fractures, the DEIS states that seepage from the bulk TSF will flow laterally to the SCP and that some could also flow vertically downwards into deeper bedrock fractures (pg 4.17-4). Table 4.17-1 states that diverted groundwater would be "largely captured, treated, and discharged." Other sections of the DEIS imply that 100 percent of the seepage would be captured. We recommend resolving these conflicting statements and that the EIS describe how much seepage could flow into deeper bedrock fractures, where these fractures are located, and the extent to which these fractures could contaminate groundwater and transmit it beyond the mine site during operations, closure and post-closure.

The DEIS states that seepage through the embankment would be about nine cubic feet per second and seepage to groundwater would be 0.1 cfs (Section 4.17.3.1). The DEIS Geohazards Section (Section K4.15.1.4) states that seepage would be from 3 to 14 cfs and up to 20 cfs. The water quality section (Section 4.18.3.1) states that seepage would contribute 0.2 cfs to underlying groundwater (assumed to be accurate within a factor of 5) as compared to 9 cfs through the embankment. To resolve inconsistent estimates provided in the DEIS of seepage from the bulk TSF, we recommend that the EIS consistently describe the estimates of seepage through the embankment, to shallow groundwater, and to deeper bedrock fractures and that the EIS describe the uncertainty associated with these estimates.

Bulk TSF Seepage Adaptive Management and Contingencies: The DEIS states that "because tailings along the northwestern ridge of the bulk TSF would be built up higher than the two saddles along this ridge, it is possible that there would be a potential for groundwater flow paths through these saddles in late operations" (pg. 4.17-14). According to the document, "contingencies such as relief wells and/or seepage recovery wells would be implemented" if seepage through the ridge is detected by piezometers

along the ridge and downstream. However, no details are provided regarding the adaptive management strategy that would be used to monitor, detect, and respond to any uncontrolled potential seepage. Nor does the referenced technical report (Knight Piésold 2018n) provide this detailed information. We recommend providing a detailed plan to detect and respond to uncontrolled potential seepage through the saddles and elsewhere as a reference document and summarizing the findings in the EIS.

Water Balance and WTP Capacity: The DEIS (Section 4.16.3.1) states that the water balance estimates may be subject to significant uncertainty since the predictions of groundwater flow to the pit are more likely to be low than high, and therefore the WTPs may need to process and discharge more water than currently anticipated (during both operations and closure). The DEIS does not include whether the WTPs are currently designed to treat higher flows and significant impacts to water quality could occur if the water treatment plant designs are based on an underestimate of the volume of water that will need to be treated. As noted above, we recommend revising the groundwater model and the water balance model to reflect higher pit inflow and also comparing the updated water balance results to WTP capacities so that the ability of the WTPs to treat the expected volume of wastewater is evaluated and included.

Excess Water Adaptive Water Management: The DEIS describes conceptual and general strategies for managing excess water at the mine site (pg 4.16-8). Given the uncertainty associated with the water balance estimates and the real potential for excess site water, we recommend that the EIS further examine the strategies and discuss their implementation and effectiveness to manage excess water. One of the strategies includes directing excess water to the open pit; we recommend that the EIS explain how this strategy could be implemented in practice, since the open pit is to be kept dry during mining. Another strategy is to direct excess water to the bulk TSF; we recommend that the EIS explain how this strategy could impact the freeboard and stability of the TSF. Conceptual adaptive strategies are listed, but an adaptive management plan is not provided. We recommend providing an adaptive management plan that describes the monitoring, trigger levels, and actions that would be taken in the event of water flows or chemistry that is greater than predicted, to enable determination of how adaptive management would be implemented and whether it would be effective.

Additional Hydrology Comments & Recommendations

Following are additional comments related to groundwater and surface water hydrology.

Groundwater Hydrology

Characterization of Aquifers and Confining Units: The DEIS displays cross-sections developed from borehole data to illustrate the subsurface distribution of aquifers and confining units in the mine vicinity. While the document states that the cross-sections illustrate lateral variability in surficial geology, this conclusion does not appear to be drawn from the figures. We recommend showing the extent of the aquifers on a plan view figure and providing additional information to clarify whether the aquifers and confining units in the mine vicinity are considered continuous or discontinuous.

Figures are also included to illustrate shallow groundwater flow patterns in the surficial aquifer at seasonal low and seasonal high-water levels (Figure 3.17-9a and Figure 3.17-9b). We recommend providing data points and representative elevation measurements utilized to generate the flow contours to show how the measured data support the contours. (Pg 3.17-4/3.17-6)

Characterization of Groundwater and Surface Water Interaction: We recommend providing additional information regarding how surface and groundwater interact across the mine site area, including an assessment/quantitative estimates of discharge from and recharge to groundwater (e.g., locations, forecasted volumes, seasonal variations, etc.) to indicate the extent of surface/groundwater interaction. This information could be provided in the EIS as a range of the minimum, average, and maximum discharge/recharge values. The DEIS concludes that the majority of stream reaches in the region are "gaining" reaches, that is, they receive groundwater discharge from the underlying aquifer. Losing stream segments are shown in Figure 3.17-11, however, a limited number of data points are displayed on this figure. We recommend that the EIS describe how determinations regarding which reaches are gaining versus losing were made, and that the Corps provide additional data points and representative elevation measurements where needed to support such determinations (i.e., relevant surface water and groundwater measuring points and values). We also recommend providing additional figures in the EIS that show representative gaining and losing scenarios based on existing data. (Pg 3.17-21/3.17.1.7)

Characterization of Flood Hazards: The DEIS states that because the project area watersheds "… are essentially undeveloped, a pre-mine flood hazard does not exist." This statement appears to neglect other potential factors contributing to flood hazard, such as soil moisture content and extreme precipitation events. We recommend including additional discussion in the EIS to support the conclusion that baseline conditions throughout the project area include zero risk of flood hazard.

Water Management Pond Impacts to Groundwater: The DEIS acknowledges that "impacts to groundwater from the main WMP and open pit WMP would occur" (pg. 4.17-12) but provides little detail regarding the extent and magnitude of the impacts to groundwater elevations and flow. We recommend that the EIS include additional information regarding the potential impacts to groundwater from the WMPs. In addition, we recommend clarifying the statement in the DEIS that "effects could slightly exceed historic seasonal variation but would not extend beyond project component areas" with regard to magnitude and extent of impacts to groundwater elevations, as well as clarifying how the extent of impacts will be assessed beyond the component areas.

Private Groundwater Wells: The DEIS discloses the presence of 11 private groundwater wells within 0.5 miles of the pipeline infrastructure on the eastern side of Cook Inlet and provides a figure showing the location of those wells. While Section 4.17 acknowledges that the horizontal directional drilling (HDD)-installed pipeline would be expected to intersect aquifers used by these private wells, it does not address the potential for impacts to water quality or quantity. We recommend that the EIS evaluate and explain whether any hydrologic impacts are expected to affect private wells in the project vicinity and the plans for adaptive management as well as community outreach and support for safe drinking water should a pipeline failure occur.

Key Issues Summary, Table 4.17-1: We recommend that the uncertainty associated with the estimates to changes in groundwater be included in the table or as a footnote, particularly since they may be underestimated due to significant uncertainty identified in the groundwater model.

Surface Water Hydrology

Streamflow Changes: The DEIS (Section 4.16.3.1) states that streamflow predictions during operations and closure may be subject to significant uncertainties due to underestimates of groundwater flow into the pit. This could result in stream reaches that are not currently predicted to be impacted to be impacted, due to the underestimation of groundwater flow to the pit. As discussed above (see our

recommendations for the groundwater model), we recommend that the groundwater modeling be revised based on higher inflows and that predicted changes to water balance, discharge volumes, and streamflows be subsequently revised such that the EIS more accurately predicts the magnitude and extent of streamflow impacts during mine operations, closure and post-closure.

Tables 4.16-2 and 4.16-4 provide estimates of the changes in average monthly streamflow during operations at a 50th percentile probability. We recommend providing summary tables in the EIS that show the changes associated with low and high flows. The 5-year low, 10-year low, 5-year high, and 10-year high flow information is provided in the cited reference, AECOM 2019b. The extent and magnitude of changes in streamflow are important to characterize in Section 4.16 and are also important for the subsequent sections that describe impacts to wetlands and aquatic resources (due, in part to these streamflow changes). Because of the importance of this information, we recommend including the low and high flow tables from AECOM 2019b in the EIS and/or Appendix K4.16 rather than in a reference document. In addition, we recommend adding figures to the EIS that show the locations of the stream reaches shown in Table 4.16-2, so that the geographic extent of streamflow changes are more fully explained.

<u>Operations Water Management</u>: According to the DEIS, the average annual process water surplus treated and discharged during maximum operations is estimated to be 29 cfs. We recommend further discussing the uncertainty around this estimate, particularly given the significant uncertainty in open pit water inflows (see Hydrologic Modelling comments, above). There are statements in the DEIS that the treated water discharges will be managed to optimize downstream fish and aquatic habitats. We recommend that the EIS provide a description of the system for managing treated water discharge and assess its effectiveness at optimizing downstream habitats.

<u>Design Criteria (Freeboard) for Water Management Structures</u>: We recommend that the DEIS provide numerical values related to the inflow design flood and freeboard in feet for the WMPs, SCPs and TSFs (see Table 4.16-1) or otherwise show that these facilities are designed with adequate freeboard and factors of safety, pertinent to both the Surface Water Hydrology and Geohazards (Section 4.15) environmental consequences sections.

<u>Water Extraction Impacts Along Transportation Corridor</u>: The EIS would be strengthened by additional evaluation of the potential effects from water extraction during construction and operation along the transportation corridor. Both temporary and long-term water extraction has the potential to reduce streamflow, alter wetland hydrology, and affect fish habitat. The DEIS, Chapter 2, provides a summary of water extraction sites and estimated annual water use, along with the length and area of access roads that would be constructed to extract the water. The specific locations of water extraction, the anticipated rate of extraction, and years of use are provided in Appendix K2. Many water extraction sites are stated to operate throughout the "life of mine" in Appendix K2, including four stream locations and five lake locations under Alternative 1. We recommend that the EIS provide additional information and analysis to further explain the amount of water available at each extraction site, in order to better support conclusions regarding the effects of these water withdrawals on streamflow and fish habitat. Furthermore, the discussion of effects resulting from water extraction is limited to those on waters that contain anadromous fish. The DEIS states that "[p]ermit compliance would avoid the potential for impacts from water withdrawal at streams" (pg. 4.16-30). We recommend that the EIS explain whether anadromous fish are located at every water extraction site, and therefore whether this conclusion is appropriate for every water extraction site. We further recommend that the EIS discuss the types of measures that the permit would require to protect fish generally, including anadromous fish, and how

impacts would be reduced using those measures. We recommend that for each extraction site, the DEIS explain how much water, wetlands, and habitat are currently present (the baseline), and the potential for impacts to streamflow, wetland hydrology, and fish habitat. We recommend that the analysis include information about the specific water bodies where water extraction will occur, including more information than a simple water resource categorization of "stream," "lake," or "pond," and that the analysis include a comparison of proposed water extraction to streamflow data collected from stream gaging stations (Figures 3.16-4 and 3.16-15).

Amakdedori Port Design and Analysis of Nearshore Sediment Transport: The DEIS provides a cursory discussion and analysis of coastal processes and does not include a coastal engineering assessment for the Amakdedori Port location, nor an assessment of the prevailing littoral drift direction along the shoreline in that area. The drivers and magnitude of shoreline sediment transport processes and sediment sources are not discussed, nor are the long-term changes (erosion, accretion, substrate characteristics) to the shoreline and associated resources (e.g., at the mouth of Amakdedori Creek). Statements in the DEIS that no predominant littoral sediment transport nor alongshore currents exist at Amakdedori Port are based on "historical and current photos of the coastline," though the details, scope, and sufficiency of this analysis are not provided. In addition, the document states that the shoreline is currently "in equilibrium," and that while some accumulation at the base of the causeway is inevitable, there are no signs that such accumulation would be large or persistent. We recommend that the EIS more fully explain the details and analysis supporting this statement.

Proposed construction of the Amakdedori Port marine facility (11 acres) includes an earthen access causeway (500 feet wide x 1200 feet long) extending out to a marine jetty, located in water depth -15' below mean lower low water (MLLW). The marine jetty (120 feet wide x 700 feet long) would continue to extend into the Bay from there and would be a sheet pile cell structure filled with granular material. Thus, the overall structure would extend perpendicular to the shoreline, almost 2000 feet into Cook Inlet (see Figures 2-28 and 2-33), and would affect coastal processes in this area. Therefore, we recommend conducting a coastal engineering analysis specific to the two marine port alternative locations to assess the effects of the alternative port causeway/jetty structures on adjacent shorelines, sediment transport processes, and associated resources. We recommend including the information in the EIS to further support conclusions regarding potential impacts to nearshore sediment transport.

The Amakdedori Port description states that "dredging of the port site would not be required." Required navigable depths for fully loaded lightering barges and marine traffic other than tugs (12-foot draft) are not provided, and there is currently no analysis to support the statement that maintenance dredging would never be required at this site. The previously recommended coastal engineering analysis would also provide a prediction of the frequency and potential volumes of sediment associated with any maintenance dredging required for each alternative for decision makers and the public to consider. We additionally recommend evaluating and disclosing the impacts to the immediate and adjacent shoreline from the pile-supported causeway and jetty variant (Section 2.2.2.7 Action Alternative 1 – Pile-Supported Dock Variant), as dense piling structures affect sediment transport.

Diamond Point Port Design and Analysis of Nearshore Sediment Transport: The DEIS lacks a sediment transport assessment, and we have the same recommendations on this topic for the Diamond Point alternative as for Amakdedori, although we note that the marine footprint is larger (14 acres), so impacts may be greater. In addition, the DEIS analysis anticipates dredging a -20' MLLW channel (58 acres), producing 650,000 cubic yards of dredged material. A portion of the material would be used for dock construction, with the remainder of the material placed upland for disposal (see figures 2-52 and 2-53).

The DEIS states that "[t]he frequency of required maintenance dredging is unknown but could be every 5 years." There is no supporting documentation for this statement, nor for the size of upland disposal areas anticipated to take initial and future volumes of maintenance dredged material. We reiterate our recommendation for a more complete coastal engineering analysis to support these dredging and disposal predictions. We also recommend evaluating and disclosing impacts to the immediate and adjacent shoreline from the pile-supported causeway and jetty alternative (Section 2.2.3.6 Action Alternative 2 – Pile-Supported Dock Variant), as dense piling structures affect sediment transport.

Alternative 3 – Concentrate Pipeline Variant: The DEIS (Section 4.16.5.5) concludes that the reduced discharge from WTPs associated with this alternative could result in greater reduction in stream flows than those described under Alternative 1. The significance of this reduction is not described. We recommend that the magnitude, duration, and extent of this reduction in stream flows be described in the EIS so that this alternative can be better compared to Alternative 1 and the other alternatives.

Summary of Key Surface Water Hydrology Issues: The key issues summary table (Table 4.16-5) provides summaries of mean annual streamflow changes. We recommend also providing a summary of changes due to extreme conditions (high and low flows) so that the magnitude and extent of streamflow changes is fully summarized. In addition, some of the differences among the alternatives described in the text are not provided in the key issues table (such as streamflow changes for the Alternative 3 concentrate pipeline variant) and we recommend that these be added to the table. We also recommend summarizing the uncertainty associated with these flow estimates in the table.

Impacts of Future Potential Changes in Climate: In our scoping comments, the EPA recommended that the EIS include a discussion of reasonably foreseeable effects that changes in the climate may have on the proposed project and the project area, including its long-term infrastructure. To complement the general discussion of climate change and its potential effects on aquatic resources in the DEIS, we recommend projected changes in the type (e.g., snow vs. rain) and timing of precipitation be addressed. Given the long closure and post-closure time periods that include management of the open pit and water discharges in perpetuity, the Corps should consider whether projected changes in climate should be evaluated for longer time frames than the few decades during which the mine is proposed to be operational. The DEIS refers to Knight Piésold 2009, which summarized relevant literature regarding likely changes to the climate in the mine region; we recommend that the relevant conclusions of that study, updated by recent national assessments, be discussed in the EIS. Where projected changes could notably exacerbate the environmental impacts of the project, we recommend that the EIS include more robust discussion of those potential effects. This would include the EIS assessing the impacts on the water balance and hydrology impacts of increased extreme precipitation events due to climate change. The project appears to rely on water management pond freeboards and adaptive management to respond to changes; however, an adaptive management plan is not provided, which makes it difficult to assess the effectiveness of adaptive management. We recommend that an adaptive management plan be prepared and provided in the EIS, and that it include the monitoring and specific measures to manage and mitigate impacts that could result from changes in the climate around the mine region.

WATER QUALITY

Key issues with the analysis of impacts to water quality include: poor representativeness of the geochemical dataset, lack of supporting information for many assumptions regarding the behavior of leachate, need for additional information to assess the effectiveness of water treatment at closure, incomplete detail to evaluate the effectiveness of seepage management, incomplete data quality

assessment for background water quality data, lack of a modeling sensitivity and uncertainty analysis, and incomplete analysis of water quality impacts in closure/post-closure phases. These issues may result in underpredictions of the magnitude and extent of impacts to groundwater and surface water quality which could result in exceedances of water quality standards. The following detailed comments describe these key issues and provide recommendations for additional analysis to fully explain potential impacts to water qualtiy. Additional comments on water quality are provided following our key comments.

Geochemical Sample Representativeness

The comments below describe the key issues with the representativeness of the geochemical dataset, which include: the lack of a quantitative analysis to support representativeness; the limited geochemical testing performed on tailings representative of the current metallurgical process; and the fact that geochemical data utilized to characterize ore and waste rock includes many samples that were collected from outside of the area of the proposed mine. Because this dataset forms the basis for the predicted water and sediment quality impacts, bias in the geochemical dataset could result in water and sediment quality predictions that are not representative of conditions during and after mining at the Pebble Project site. We recommend that only ore and waste rock samples from within the current footprint of the proposed mine and that only tailings samples that are representative of the current metallurgical process be included in the geochemical dataset to support EIS water quality predictions.

<u>Ore and Waste Rock Representativeness</u>: In several locations, the DEIS mentions that the geochemical dataset is representative of the different types of materials associated with the mine (e.g., Ch 3.18, pg. 3.18-2). However, quantitative analysis to support the conclusion regarding representativeness is not included. We recommend that this be addressed by providing a table in the EIS that shows the percentage of each ore type for the proposed mine and the percentage of samples that were used to characterize each ore type. We also recommend that the number of samples used in the characterization be similar to the percent abundance of the particular ore-type in order to more fully support the conclusion regarding representativeness.

In Appendix K3.18, Table K3.18-3 shows a summary of the rock and tailings used in the geochemical testing program. The above information could also be added to this table to support the conclusion. In addition, we recommend that this table include information regarding the sedimentary and volcanic origins of the materials associated with the mine, as well as the presence of hydrothermal alterations zones within the different types of materials, since this information is important to understand the acid generation potential of the different materials.

The geochemical data utilized in the DEIS includes many samples that were collected from outside of the area of the proposed mine. The DEIS states that "data from both the PEZ and PWZ are used, and when appropriate, combined to create a more robust dataset (SRK 2018f)" (pg. 3.18-3). The proposed project includes mining only the west pit (PWZ); therefore, data obtained from outside the PWZ are not representative of the conditions encountered in proposed project. As a result, the water and sediment quality predictions (which utilized the data from both the PWZ and PEZ) are not representative of the impacts associated with the proposed mine project.

The rationale for combining the PEZ and PWZ data is provided in the SRK 2018f reference, a draft memorandum, which had the objective of performing a "high-level analysis comparing data from Pebble East and West." The draft memorandum uses five lines of evidence to support using the combined dataset:

1. The draft memorandum provides a general description of how the PWZ and PEZ have similar geology. However, this analysis is non-quantitative and focuses on broad similarities as opposed to discussing lateral variability in the geological units, variations in the depth of oxidation, variations in the coverage of tertiary rocks, and variability in the sulfur and trace metals concentrations. In the SRK 2011a document, Table 11-1 shows the Pebble Deposit Rock types for the PEZ and PWZ. While this table shows that there are many similarities between the PWZ and PEZ geology, there are also notable differences. For example, the PWZ has the following rock types that are not present in PEZ: Quarternary Ferricrete, Pre-tertiary quartz monzonite monzodiorite, gabbro, pyroxenite, igneous breccia, skarn, and felsite. Also, the PEZ has the following rock types not present in PWZ: Tertiary Latite, siltstone, and volcaniclastic rocks. Overall, despite high-level similarities in the geology of the PWZ and PEZ, there remain significant differences when looking at more specific rock types and characteristics.
2. The draft memorandum states that the HCTs had 10 more samples from the PWZ than the PEZ (36 compared to 26). However, there is no discussion of whether the results from the humidity cell tests (HCTs) showed any significant differences.
3. The draft memorandum refers to Figure 11-27 in Chapter 11 of the SEBD which shows that there is overlap in the graph of sulfide versus sulfate release in the PEZ and PWZ. However, this analysis is based on a small dataset (n=36 samples) and only focuses on a single geochemical parameter, sulfur.
4. The draft memorandum mentions that the barrel tests had more PWZ than PEZ rock in them. However, this does not provide evidence that the leaching chemistry was not biased by the addition of the PEZ material. In addition, the data from the barrel tests was not used to develop the source term concentrations used for water quality modeling, and therefore these results are disconnected to the predicted water quality impacts from the mine.
5. The draft memorandum mentions that the shake flask tests were from the PWZ. However, this is a relatively small part of the geochemistry dataset, and, as with the barrel tests, the shake flask data were not used directly in any of the water quality predictions models.

Overall, the SRK 2018f memo makes the case for combining the PEZ and PWZ data based on the comparisons of very small datasets. Because there is a lot of variability in the geochemistry data, comparisons of small datasets will be biased towards not being able to identify significant differences between the two sample populations (i.e., the PWZ and the PEZ).

However, there is a much larger dataset of acid base accounting (ABA) results for both the PEZ and PWZ in Appendix 11B of the PLP 2018a document (>1,000 samples). Due to its larger sample size, this dataset is more well suited for addressing questions of similarities between the PEZ and PWZ. We performed statistical t-test analyses on some of this data to determine if there were statistically different concentrations between the PWZ and PEZ. Our results show that the PWZ samples had a significantly lower pH than the PEZ (t-test assuming equal variance, $t=7.76$, $df=1082$, $p<0.001$: PWZ pH: 7.4 ± 1.2; PEZ: 8.0 ± 1.5). The higher pH in the PEZ dataset suggests that combined PEZ and PWZ dataset would underestimate the acid rock drainage (ARD) risk relative to using just the PWZ data. Similarly, analysis of this dataset showed that the percent total sulfur and the percent sulfate were both <u>significantly higher</u> in the PWZ than the PEZ (Sulfur PWZ: $2.6 \pm 1.9\%$; PEZ: $1.5 \pm 3\%$; $p<0.001$, $df=1082$; Sulfate: PWZ: $0.06 \pm 0.01\%$; PEZ: $0.04 \pm 0.01\%$; $df=1082$, $p<0.001$). Again, these results show that the combined PEZ and PWZ dataset would <u>underestimate</u> the ARD risk relative to using just the PWZ data. In addition, the

concentration of arsenic in waste rock was significantly higher in the PWZ than the PEZ (PWS As: 45 ±94 ppm, PEZ: 25±35 ppm; $p=0.004$, $df=554$). These results indicate that the combined dataset would predict lower arsenic concentration than if using just the PWZ. It is also worth noting that many of the statistical tests between other metals/metalloids did not indicate that the PWZ samples were associated with higher metal leaching or ARD risk. However, in the above examples, using the combined dataset has the potential to underpredict the environmental impacts of the proposed mine for some parameters. We recommend that the dataset most representative of the project (i.e., the PWZ data only) be used as a basis for the impact assessment rather than the combined data set.

The DEIS and supporting documents focus on explaining the similarities in the PEZ and PWZ dataset (which is not entirely supportable based on the given information); however, the specific benefit of including many samples collected from outside of the proposed mine area is not established. We recommend that all PEZ data be removed from the analysis and the characterization of the impacts of the mine include only data from the PWZ, which is a more scientifically accurate approach. Alternatively, the Corps should further explain why this approach was adequate.

If the EIS analysis continues to rely on the combined dataset, we recommend providing a statistical analysis that supports this approach and that the EIS describe any limitations or influences on modeling and the conclusions made in the EIS based on use of this combined data. We also recommend that the EIS discuss limitations on statements and conclusions associated with variability in the data analysis (i.e., how variability affects modeling output and how that affects water quality predictions and conclusions).

Tailings Representativeness: The DEIS states that "limited geochemical testing has been performed on the representative concentrate because possible designs for metallurgical processes are still at an investigative stage" (pg. 3.18-3). Because the characteristics of the tailings appear to be different from the ones used in the geochemical testing, the predictions may not be representative of the actual water quality. The tailings supernatant data used to represent tailings water quality is based on tailings produced via flotation and "gold plant tails" (Appendix K4.18). We assume "gold plant tails" means cyanide leach tailings, although we recommend that this be clarified in the EIS. Since the current project processing flowsheet does not include a gold plant, these samples may not be representative of the tailings at the mine site. We recommend that metallurgical processes be established prior to conducting the geochemical analysis, such that representative information can be included in the EIS. We recommend that gold plant tails samples be removed from the data used to represent tailings water quality or that further discussion be provided in the EIS that explains the variability and uncertainty around the tailings water quality estimates due to inclusion of this data. In addition, there should be information included on how the grain size of the tailings relates to the grain size of the material used in the HCTs because this can be an important variable affecting the release of metals/metalloids.

Metal/Metalloid Mobilization and Behavior of Leachate

We recommend that the DEIS expand its consideration of several important aspects of leachate behavior, including the potential for metal/metalloid mobilization. The distinctions between PAG and non-PAG materials in the DEIS do not appear to be conservative estimates, metal/metalloid mobilization under neutral pH conditions has not been fully considered, the DEIS appears to underestimate metal/metalloid whole water concentrations, and differences in selenium, mercury, and chromium speciation are not fully considered. These issues impact the accuracy of the impact analysis and appears

to underestimate those impacts. Our detailed technical comments regarding these key water quality issues and recommendations follow.

Distinctions Between PAG and Non-PAG Materials: It appears that the distinctions between PAG and non-PAG materials are not conservative and could result in unanticipated water quality impacts. This is important because mine materials are managed differently depending on whether they are PAG or are non-PAG. Material determined in the DEIS to be non-PAG could leach metals/metalloids at elevated concentrations and impact water quality. The DEIS states: "During mining, rock materials will be assessed using the block model to determine whether the mined rocks are PAG or non-PAG, and whether the mined material would be processed and disposed as tailings, or not processed and set aside as waste rock" (pg. 3.18-5); and, "The ABA and humidity cell data indicate that PAG and non-PAG rocks can be distinguished using an NP/AP ratio of 1.4 (PLP 2018a), and are applicable to pre-Tertiary, Tertiary, and overburden materials." (pg. 3.18-3)

Although not specifically stated in the main text of the DEIS, we assume that the site-specific value of neutralizing potential to acid producing (NP/AP) ratio value of 1.4 would be used to segregate PAG from non-PAG materials. We reviewed the referenced document (PLP 2018a), specifically Section 11.7.1.3.1, and the derivation of the 1.4 value is not explained. The text references Figure 11-28, which shows a plot of NP/AP versus sulfate release, but this plot does not show specifically how the 1.4 value was derived. We recommend that the rationale for the 1.4 ratio and description of how it was calculated be described in the EIS.

Elsewhere in the supporting documents of the DEIS, a more conservative ratio value of 2 is used to indicate where the materials have uncertain acid generating potential (e.g., Figure K3.18-2 and pg. 11-9 of the EBD). Ratio values larger than 2 have also been proposed for other mine sites to provide a more conservative approach to distinguishing PAG from non-PAG. For example, the EPA's 1994 document, Acid Mine Drainage Prediction, states that, "[W]hen the ratio of a sample's neutralization potential and acid production potential is greater than 3:1, experience indicates that there is lower risk for acid drainage to develop (Brodie et al. 1991). For ratios between 3:1 and 1:1, referred to as the zone of uncertainty, additional kinetic testing is usually recommended."

There are several factors that can affect the calculation of NP/AP ratios and result in biased calculations. Uncertainties associated with these different variables is one reason why more conservative ratios (such as 2 or 3) are often used to differentiate PAG from non-PAG. Because the DEIS is using a relatively low NP/AP ratio of 1.4, we recommend that it is important that the EIS address the multiple factors that can potentially result in biased ratios. For example, in the discussion of NP/AP ratios, we recommend that the EIS provide information on the presence of non-pyrite sulfide minerals, the presence of acid-producing minerals other than sulfides, the presence of carbonate minerals that do not produce alkalinity, and the presence of non-carbonate minerals that can buffer acidity (e.g., chlorite, biotite). In addition, the PLP 2011 supporting document indicates that both the Sobek and the modified Sobek methods were used for the estimation of the neutralizing potential (NP). The modified Sobek method is preferred for the determination of PAG material because it is less likely to overestimate neutralizing capacity. We recommend that the EIS clarify whether data from both these types of tests were used in the calculations or just the more conservative modified Sobek data were used.

Distinctions Between Metal Leaching and Non-Metal Leaching Materials: The DEIS assumes that mine materials with NP/AP ratios >1.4 are non-PAG, have less risk of metal leaching and will be handled differently at the mine site compared to PAG materials. We recommend that the Corps evaluate whether

the NP/AP ratio of 1.4 is a good predictor of lower metal concentrations and explain the determination in the EIS. To address this, we analyzed the data in SRK 2011a, Table 11-10, to determine whether there were significantly lower metal concentrations associated with samples with NP/AP ratios of >1.4 for several elements (As, Cu, Hg, Pb, Se, and Zn). For As, Hg, Pb and Zn, there was <u>no significant difference</u> in concentrations depending on whether the ratio was greater or less than 1.4:

- Arsenic NP/AP >1.4: 63 ±63 mg/kg; As NP/AP <1.4: 140 ±241mg/kg, t-test p-value: 0.34, df=28;
- Mercury NP/AP >1.4: 0.10 ±.26 mg/kg; Hg NP/AP <1.4: 0.20 ±0.07 mg/kg, t-test p-value: 0.25, df=28;
- Lead NP/AP >1.4: 17 ±.11 mg/kg; Pb NP/AP <1.4: 11 ±12 mg/kg, t-test p-value: 0.24, df=28; and,
- Zinc NP/AP >1.4: 4.4 ±2.9 mg/kg; Zn NP/AP <1.4: 4.3 ±3.3 mg/kg, t-test p-value: 0.94, df=28;

Only copper and selenium showed significantly higher concentrations when the NP/AP ratio was <1.4. Our analysis shows that the NP/AP ratio of 1.4 is not a good predictor of metal concentrations and may not correctly identify materials that have the potential for elevated metal leaching. We recommend that either a more conservative ratio value (such as 2 or 3) be used to differentiate PAG from non-PAG material or that the rationale for the 1.4 ratio value be better explained in the EIS to demonstrate protection of water quality.

<u>Use of Dissolved/Filtered Water Concentrations</u>: The water quality predictions in the DEIS are based on dissolved/filtered water concentrations for metals parameters and these lower numbers are compared to State of Alaska water quality standards that are based on whole water concentrations. Our assessment of the information provided in the DEIS and supporting technical documentation indicates that the water quality predictions that are based only on dissolved metals concentrations can result in an underestimation of the metal/metalloid whole water concentrations and a biased comparison to WQS. We recommend that whole water concentrations be used instead or that the EIS further explain why the current analysis is sufficient as discussed below.

Chapter 3.18 p 3.18-4 of the DEIS states that "[e]lement release rates determined from kinetic tests, which were performed on both filtered and unfiltered samples, were mainly a function of leachate pH rather than the element content of the samples (SRK 2011a)." While it is correct that the barrel tests analyzed dissolved and whole water fractions, the other kinetic tests (HCTs, the saturated column tests, and the stored bag tests) did not perform that analysis. Most importantly, the HCTs release rates were used in generating the source term element releases rates that were incorporated into the water quality modeling. The results from the barrel tests do not appear to be directly used in the water quality modeling and the distinctions between the dissolved and whole water concentrations obtained from these tests is not discussed or analyzed in the DEIS or supporting documents.

The SRK 2018 document, Geochemical Source Terms for Water Treatment Planning, (SRK 2018a) states that the modeling source terms were developed based on dissolved concentrations and that this is a limitation of their use in predictive water quality modeling. SRK 2011a, Appendix 11J includes a table that provides whole water and filtered water concentrations from the barrel tests. Doing a statistical paired t-test for the whole water and filtered water shows that for some metals the whole water values are significantly higher. For example, the whole water aluminum concentrations were 29 percent higher than the filtered concentrations (p<0.001); the whole water iron concentrations were 17 percent higher

(p=0.001) and the whole water mercury concentrations were 79 percent higher (p<0.001). These results indicate that water quality predictions included in the DEIS based only on dissolved metals concentrations are underestimating the whole water concentrations. We recommend that the ratios of whole water to filtered water from the barrel tests be used in the EIS to estimate the whole water concentrations from the dissolved values that are provided by the model.

<u>Metal/Metalloid Mobilization Under Neutral pH Conditions</u>: We recommend that the EIS analyze the potential impacts from metal/metalloid mobilization under neutral pH conditions. As stated in the DEIS: "metalloids such as arsenic, molybdenum, and selenium, and salts such as sulfate, can be released into the environment even if the water draining the rock has a neutral or basic pH" (pg. 3.18-3); and, "[F]or some elements (arsenic, molybdenum, and selenium), release can be environmentally significant under neutral pH conditions, as described in SRK (2011a)" (3.18-4). Because determinations regarding how a material will be handled (i.e., whether it can be used for road construction, etc.) will be based on whether it is PAG or non-PAG, there is the potential that non-PAG materials could become sources of some metals/metalloids leached under neutral pH conditions. We recommend that the EIS consider this potential when discussing non-PAG material to determine if there are elevated concentrations of metals/metalloids that could be mobilized under neutral pH conditions. This is particularly important for areas where the runoff from these materials would not be captured by any water treatment facility.

<u>Influence of Bulk Metal Concentrations Versus pH on Leaching Rates</u>: Statements in the DEIS indicate that the leachate pH is a more important variable than the element content of the mine material for predicting water quality impacts. This assumption does not appear to be supported by statistical analysis and could result in an underestimation of water quality impacts from materials with elevated metal/metalloid concentrations but lower acid generating potential. The DEIS states, "Element release rates determined from kinetic tests, which were performed on both filtered and unfiltered samples, were mainly a function of leachate pH rather than the element content of the samples (SRK 2011a). Leaching of copper accelerated as pH decreased; therefore, the potential for metal release is linked to the potential for acid generation, and ABA data can be used to assess the potential for copper leaching." (pg. 3.18-4)

A review of SRK 2011a shows that this statement is based on information in Figure 11-55 and 11-56 as well as Table 11-43, each of which are discussed in more detail below:

- Figure 11-55: This figure shows the copper (Cu) release rate plotted as a function of the total Cu content. In the figure, the highest release rates are associated with samples with pH<6; however, these samples are also associated with the highest bulk phase Cu concentrations. The figure and associated text do not provide any statistical analysis to support the statement that the pH is a larger driver of the Cu in leachate compared to the Cu content of the bulk material;
- The DEIS, and supporting document SRK 2011a, do not provide a table where the pH values associated with the element release rates are provided, and as such, it is not possible for reviewers of the EIS to perform the statistical analysis necessary to determine the relative importance of pH versus bulk phase element concentrations. In lieu of having that information, the EPA extracted/estimated data from Figure 11-55 using a web plot digitizer and performed a simple linear regression analysis between the bulk Cu concentration and the release rate. The results of this analysis showed a highly significant relationship (p=0.00001). While this analysis does not show that the bulk concentrations are a larger driver than pH in the Cu release rates (that would require multivariate analysis), it clearly shows that the bulk concentrations are an important factor affecting the Cu release rates;

- Figure 11-56: This figure provides similar information as 11-55 mentioned above, but instead focuses on Arsenic (As). Based on our visual assessment of the information included in this graph, the figure does not provide enough information to support the original statement in the DEIS regarding the importance of pH;
- Table 11-43. This table provides the summary information on the relationship between bulk concentrations and leaching rates. In the table, the correlation coefficients are presented for specific pH ranges (pH<3, pH<6 and pH>6). When the DEIS discusses leaching rates at neutral pH conditions, we presume that the discussion refers to leaching at pH>6, although we recommend that this point be clarified. Because rainwater pH is ~5, we recommend that the data be consolidated into categories of pH values less than and greater than 5, as this split is more relevant to field conditions at the mine site. Because the analysis in the DEIS relies on the assumption that non-acid generating conditions would occur at a pH of 6, the DEIS might be underestimating element leaching when exposed to rain water;
- Table 11-43 does not provide information on whether the correlations are significant, or the sample size associated with the analysis. These are both important pieces of information to include for the interpretation of the data in the table; and
- In Table 11-43, most elements have higher correlation coefficients at higher pH values (<6) relative to lower pH values (<3). Examples of this include the following elements: Al, As, Ba, Be, Bi, Ca, Cd, Co, Cr, Fe, Mn, Ni, Pb, Sb, and Se. Examples showing that the best correlation occurred at pH<3 include: Cu, Hg, K, Mg, Mo, and Zn. The text in SRK 2011a states, "For the acid leachates, some stronger correlations were observed, particularly in the case of the very acidic leachates (pH less than 3)." However, there were 15 elements that had higher correlations at pH<6 than at pH<3, and there were only six elements where the correlation was stronger when pH<3. As such, we recommend that the EIS include additional data to support this statement, as well as to support the statement in the DEIS regarding the importance of pH over bulk element concentrations in driving element leaching.

The multivariate component to element release rates is acknowledged on pg. 11-55 in the SRK 2011a document, which states that "[i]t is possible that the pH effect is masking any relationship that might have been present between the metal release rates and the bulk composition." In summary, we recommend that multivariate statistical analysis be used to determine the relative influence of bulk metal concentrations versus pH on leaching rates. Alternatively, the Corps should further explain why its existing analysis is sufficient.

<u>Timeframe for the Development of Acidic Conditions</u>: The timeframe predicted for the development of acidic conditions may be underestimated and future mine expansion activities may delay the aqueous storage of PAG materials and result in some materials becoming acid generating and having higher metal/metalloid leaching rates than are predicted in the DEIS. The DEIS states that "[p]aste pH results for aged rock cores stored at the site suggest that acidification may be delayed up to 40 years for 95 percent of the pre-Tertiary mineralized rock (SRK 2011a). Given differences in the test conditions, laboratory and field tests suggest that oxidized pre-Tertiary mineralized rock may take up to several decades for acidification to occur." (pg. 3.18-3). In reviewing the SRK 2011a document, it is not clear whether the rock cores were aged intact or crushed. If they were relatively intact, the greatly reduced surface area would limit the oxidation rate and these rates/time frames would be much longer than if the test was performed on crushed material, which may be more representative of actual site conditions. We

recommend that the EIS provide additional information regarding the grain size of the aged rock cores and how this would impact the acid rock drainage ARD timeframe.

The SRK 2011a reference also states that, "ARD generation under site conditions is at least a decade to several decades," and PLP 2018a states that, "Under field conditions, onset of acid generation is expected to be delayed by at least two decades." We recommend verifying which reference accurately reflects anticipated onset of acidic conditions in the waste storage areas and updating the information in the EIS.

Metal/Metalloid Speciation: Differences in selenium, mercury, and chromium speciation are not discussed in the DEIS. These metal/metalloids have different toxicological properties depending on their speciation, which we recommend be taken into consideration when determining the impacts of releases into the environment.

- For selenium, there is potential for the WTP to alter selenium speciation and potentially increase its toxicity. This is particularly important because the Se levels leaving the WTP are expected to be 5 µg/L, which is the concentration value of the water quality standard (Table B1.3 in Knight Piésold 2018a). From the dust deposition estimates, the Se concentrations in water are expected to increase by 0.65 percent (considered to be an underprediction and specifically discussed elsewhere in our comments). While this increase is relatively small, if the increase in Se concentration is added to the 5µg/L Se that is leaving the treatment plant, this could result in an exceedance of the 5µg/L surface water quality standard for Se; though there would be dilution occurring downstream which could lower this concentration. We recommend that the Se in the effluent from the WTP be further reduced through treatment methods available, to ensure that surface water quality standards are met when taking into consideration the additional Se inputs from fugitive dust deposition. Otherwise, the combined impacts of the project could result in an exceedance of water quality standards and violations of the CWA. If the WTP design and treatment process is not reconsidered, then we recommend that the EIS explain that it is known that the water quality standards for selenium could be exceeded.

- For mercury, there is potential for the formation of methylmercury (MeHg). MeHg is the more toxic and bioaccumulative form of Hg that can be produced under anoxic conditions and is associated with the activity of sulfate reducing bacteria. Appendix K4.18 states that, "PitMod predicts that the pit lake will become thermally and chemically stratified after about closure years 25 to 30 (Lorax Environmental 2018)" (pg. K4.18-40). The anoxic water in the stratified pit lake would provide good conditions for Hg methylation, and MeHg production could be quite large because of the high Hg concentrations in the pit lake (median concentrations predicted to be 113 ng/L) and sulfate concentrations >1,000 mg/L. While the pit lake water will be treated to meet water quality standards prior to discharge, the water treatment focuses on reducing inorganic Hg ion concentrations which have a +2 charge, whereas MeHg has a +1 charge. This difference in speciation may decrease the efficiency of the treatment facility to reduce its Hg concentrations. We recommend that information be added to the EIS that addresses Hg speciation, specifically as it applies to MeHg production.

  Table B1.3, in Knight Piésold 2018a, shows that the predicted WTP outflow concentration of sulfate would be 151 mg/L. While this concentration is below the sulfate water quality standard, at 250 mg/L, it is an order of magnitude above the existing condition concentrations in the receiving water bodies. This large addition of sulfate could stimulate Hg methylation

downstream of the mine. Studies have shown that the addition of sulfate can increase MeHg production rates, even when the inorganic Hg concentrations have remained constant (Branfireun et al., 2001; Wasik et al., 2012). We recommend that the EIS address the potential for downstream MeHg production as a result of increased sulfate loading and also identify options to further reduce sulfate releases from the WTP.

The temperature corrections applied to the HCT release rates may underestimate leaching rates encountered at the mine site. For example, SRK 2018a states that, "The rate of accumulation of this load is indicated by weathering rates (on a mass basis) determined in humidity cells corrected for lower site temperatures and lower particle surface areas." Use of an annual average air temperature could underestimate the weathering rates because the subsurface temperature within the waste rock/tailings and under snow cover will be significantly warmer than the air temperature. We recommend that the EIS include information on the site temperature that was used for this correction to confirm accuracy of the leaching rate estimates.

Water Quality Modeling

Our key issues related to the accuracy of the water quality modeling are detailed in the comments below.

Sensitivity and Uncertainty Analysis: A sensitivity and uncertainty analysis is the standard practice in the majority of major mine project EISs. This is important for identifying which input parameters are the most influential on the model outputs, in identifying the impact of how uncertainties in model input parameters would affect the outputs, and in establishing confidence in the model results. We recommend that a sensitivity and uncertainty analysis of the water quality modeling be conducted consistent with EPA guidance on environmental modeling (see reference under "Hydrologic Modeling" above). One particularly important area to be addressed by the uncertainty analysis is the related unknowns associated with the geochemical sample representativeness (see our comments on that topic, above). We recommend that uncertainty related to geochemical information be included in the modeling analysis by applying a range of values that could be the upper and lower end of potential concentrations.

For the source term chemistry, the upper 95th percentile of the data are utilized to provide a conservative estimate of water quality concentrations (Appendix K4.18, pg. 4.18-40). However, there are model components that are not based on source term concentrations that can also impact the model outputs (e.g., temperatures, infiltration rates, porosity, etc.). We recommend that the variability in these other model components be included in a sensitivity and uncertainty analysis and the information included in the EIS.

The water quality modeling included several assumptions, such as steady state, complete mixing, and no reactivity or degradation occurring. We recommend that the EIS include a discussion of the limitations of the model predictions and limitations of the subsequent use of the predicted data (pit, water treatment, etc.) during operations and closure, resulting from these assumptions.

Use of 95th Percentile of the Source Term Concentrations: As mentioned above, in lieu of performing sensitivity and uncertainty analysis, the DEIS states that model results are expected to be conservative/protective because they utilize the 95th percentile of the source term concentrations (Appendix K4.18, pg. K4.18-14). However, SRK 2018a, the document that describes the source term calculations, states that "[w]here the mean would be considered the best representation of the most likely condition and extreme low and high values will offset each other, the input was calculated as the upper

95% confidence limit on the mean (i.e., representing the statistical uncertainty on the mean)." There is an important difference between using the 95th percentile of all the data versus using the 95% confidence limit of the mean, with the latter being significantly less conservative. If the model is going to rely on using 95th percentile data, we recommend that this be used on the entire dataset, i.e., not only on the mean value, to provide a more conservative estimate of the potential water quality impacts from the Pebble Project.

The SRK 2018a source term document states that, "[r]elease rates per week (mg/kg/week) are calculated for each parameter for each week, based on the concentration (mg/L), leachate volume recovered (L/week) and mass of the sample (kg). 95th percentile rates are calculated separately for each major rock type category and grouped by pH of the leachate." We note that separate source terms were developed for ~15 different types of material based on data from ~100 HCTs. If we understand correctly how these calculations were made, that would mean that, on average, seven HCT results would be available for each of the different types of material tested. Seven results represent a small sample size from which to develop a 95% confidence interval. We understand that the 95th percentile is used in the DEIS to infer a degree of conservativism in the dataset, however, we do not recommend basing an EIS impact analysis on the 95% confidence intervals of datasets with very small sample sizes. The variability in the data from a few samples may not be representative of the full range of variability encountered at the mine site, and therefore, the 95% confidence interval may not provide estimates with a high level of certainty to support the water quality predictions.

<u>Source Term Concentrations</u>: It appears that the source term concentrations used in the water quality model predictions underestimate the magnitude of the water quality impacts. For example, SRK 2018a states that "[t]he average rate following the end of the flush is calculated for each test." By excluding the first flush of elevated metal/metalloid concentrations in the source term calculations, the modeled water quality concentrations during mine operations are underestimated. While the first flush effect may be temporally isolated for a given sample of rock, at an active mine site, fresh rock/ore is being generated daily. As such, the first flush effect considered to be a temporally isolated event in the HCTs will continue throughout mining operations, as new material is regularly exposed to water. While the percentage of material experiencing the first flush effect at the mine site decreases over the course of the mine life, the complete removal of these initial elevated concentrations from the modeling exercises likely will result in an underestimation of the actual water quality impacts. Therefore, we recommend that water quality modeling include the first flush effect in the source term calculations. Alternatively, the Corps should explain why its existing analysis is sufficient.

<u>Use of Predicted pH</u>: The pH was not modeled for any of the water sources previously modeled by GoldSim, however the DEIS pH is reported as "predicted" in the DEIS. Pg. K4.18-45: "PHREEQC predicts that the pit lake surface water would have slightly basic pH (7.6 to 8.2) within discharge limits." Lorax Environmental 2018 states that, "Source terms used in the pit lake model were obtained from KP (2018) [Knight Piésold 2018d, closure water management plan], SRK (2018) [SRK 2018a, source term memo] and HDR (2018) [HDR 2018a, Pebble Base-Case Water Treatment Plant Engineering Revision]." It also states that input data were from the Year 15 data from KP, which corresponds to Closure Phase 1. Knight Piésold 2018d states that, "pH was not modeled", and there are no entries for pH in Table B2.1 for Closure Phase 1. HDR 2018a includes a footnote on the results table that input came from the Knight Piésold 2018a (operations water management plan), which provides pH values of "7 to 8" for all sources, but has a footnote that, "pH was not modeled and pH values are based on the range of pH source terms provided by SRK (dated 20 June 2018)." Additionally, the SRK source term document (the input for the GoldSim modeling that gave output used by PitMod) states that pyritic

tailings were considered non-reactive due to saturated conditions. We note that those are not the conditions that would exist at the start of the pit filling with water, since material would be moved over several years and be exposed to atmospheric oxygen before the pit would reach saturated conditions. Finally, pit lake water quality predictions for all metals are summarized in Table K4.18-7 and Table K4.18-8 for Closure Phases 1 and 2, respectively. These tables also have footnotes stating that pH was not modeled. If the pit lake modeling (PitMod) used the seven to eight values from Knight Piésold 2018a (via HDR 2018a) for pH as input to the model, the pH output may be invalid because pH was not modeled to be used as input to PitMod. On page 4.18-12, the DEIS states that the pit water is expected to initially be acidic, so it is important to explain what pH value was used as input to PitMod.

We recommend removing the word "predicted" from the EIS discussion on pH, where modeling did not occur, and/or that the EIS clarify that pH was not predicted based on modeling. We also recommend explaining why pH was not modeled in GoldSim, since pH is a parameter that controls geochemical reactions. It may be that pH is not as important for the water treatment plant influents, since the pH likely would be assessed at the time of treatment to ensure proper dosing of chemicals; however, we recommend that it is important to understand the actual pH and speciation of metals/metalloids/non-metals in the mine site water reporting to the TSFs and the concentrations that might be expected to occur in the overlying pit water and tailings pore water that may be released accidentally through a failure or through seepage that escapes capture.

We recommend that the EIS also provide the value of pH used for input to the pit model, include support for statements regarding pH of the pit water, and discuss limitations on discussions and conclusions made based on use of the non-modeled pH. We also recommend that the EIS discuss limitations of using an assumed pH instead of a modeled pH, with respect to water treatment and water quality in seepage or from potential releases from storage facilities (TSFs and ponds) and on potential impacts from releases and management of materials.

Water Management and Treatment and Water Quality Impacts

<u>Operations Water Treatment Plant Performance and Impacts</u>: Regarding the operations WTPs (WTP #1 and #2), the DEIS states, "Based on an independent review of the WTP source terms and processes (Appendix K4.18, AECOM 2018i), discharge water from both WTPs is currently expected to meet ADEC criteria…" (pg 4.18-4). However, the independent review (AECOM 2018i) specifically did not conclude that WTP #2 is expected to meet the State of Alaska water quality standards. Instead it recommended additional investigation and mitigation measures and/or development of improved management processes to provide confidence that salt and selenium are properly sequestered and stabilized for long-term management in the solid form, and to ensure that WTP performance will meet treatment goals.

We recommend including a full discussion of the issues identified in AECOM 2018i regarding the potential for salt and selenium build up. The DEIS indicates that these issues "may" require further investigation as design progresses and/or as a long-term adaptive management strategy (pg 4.18-5). We recommend that language in the EIS accurately represent the AECOM 2018i reference document and the importance of the issues and recommendations of the independent review by deleting the term "may" and discussing the previously recommended additional investigation and appropriate up-front WTP design.

We recommend that PLP conduct the additional investigation recommended in AECOM's independent review and, based on the investigation, provide a revised design plan for WTP #2 that acknowledges and responds to the potential for salt and selenium buildup by describing what specifically will be done to either prevent it or to treat the higher total dissolved solids (TDS) and selenium levels in order to meet surface water quality standards. Whereas the DEIS states that more treatment units would be added, the EIS would be strengthened by describing the specific water treatment processes proposed, the flows and concentrations for which they would be designed to manage and the predicted effluent quality under average and high flow conditions. If this information is not provided in an updated project description and water management plan, then we recommend that the EIS base its water quality impact analysis on what is proposed, which is a WTP (WTP #2) with uncertain effectiveness, based on AECOMs independent review.

Closure Water Treatment Plant Performance and Impacts: It appears that the DEIS mischaracterizes the results of an independent review conducted by AECOM of the closure WTP process and the ability of the water treatment plant to meet water treatment goals and water quality standards and we recommend that the EIS clarify this issue, as discussed below.

Regarding closure WTP #3, AECOM's independent review referenced in the DEIS concluded that, "Insufficient information on WTP #3 design and process is currently available to assess effectiveness." The DEIS Appendix K4.18 states, "Water quality of the discharge from the open pit WTP is the subject of ongoing engineering analysis (PLP 2061-RFI 106)" (pg. K4.18-52). The DEIS concludes in Chapter 4.18 that "[i]n terms of magnitude and extent, the treated water would be discharged to the environment downstream of the mine site in Frying Pan Lake" (pg 4.18-13), and "[p]it lake water quality would exceed standards but would be pumped to maintain operational levels and treated prior to being discharged to the environment." (pg. 4.18-32). The DEIS does not specifically state that the treated water discharge would meet surface water quality standards, and does not reflect the conclusion of the independent analysis that information is currently insufficient to assess the effectiveness of the WTP #3 design and process.

We recommend that the Corps further supplement the information available in the DEIS to assess the effectiveness of water treatment at closure, because at present it appears to be a data gap. Currently, the impacts to surface water quality at closure from the WTP discharges cannot be assessed. We recommend that: 1) PLP develop a robust design for WTP #3 that will ensure that the discharge of the treated open pit water meets water quality criteria under the CWA and the State of Alaska water quality standards, and that PLP include the revised WTP #3 design and process in an updated project description, plan of operations or water management plan; and, 2) the Corps independently review, analyze and explain in the EIS that the revised WTP #3 design will result in discharges such that surface water quality standards will be met at mine closure. The DEIS does not currently include a flowsheet of the closure water treatment process and we recommend that be provided. Alternatively, we recommend that the EIS explain why its existing analysis is sufficient to support a conclusion that treated water discharged from WTP #3 will meet water quality standards at closure.

Bulk TSF Seepage Closure Water Treatment: The DEIS states that seepage water from the bulk tailings TSF embankment would be collected and treated until treatment is no longer necessary, anticipated after closure year 50 (Section 4.18.3.1). However, the reference for this statement (Knight Piésold 2018d) indicates that TSF seepage will require treatment over the long term. We recommend that the conflicting statements regarding how long seepage water will require treatment be addressed in the EIS to clarify the Pebble Project impacts on water quality.

Characterization of the Extent of Groundwater Contamination: As mentioned previously in this enclosure, the DEIS states that all seepage would be captured, however, there is no design information supplied regarding the seepage collection and monitoring well/pumpback system to support this conclusion. We recommend that such design information be analyzed in the EIS.

In addition, we recommend that the EIS include additional details to support the characterization of the lateral and vertical extent of groundwater contamination to both shallow and deep groundwater from the mine site features during mine operations, closure and post-closure. The groundwater model predicts that contact water that leaks through the WMP liner to shallow groundwater would migrate about two miles, unless it is captured by foundation drains and the monitoring well/pumpback system (Appendix K4.17). We recommend that figures be added that depict the lateral and vertical extent of groundwater contamination for constituents that exceed standards in shallow and deep groundwater from the bulk TSF, pyritic TSF, and WMP so that the extent of groundwater impacts are more fully explained. This information is routinely provided in mining EISs to show the magnitude and extent of groundwater impacts

The DEIS states that "groundwater quality beneath the NFK west and NFK east drainages in the immediate vicinity of the mine site would be impacted during operations but would be expected to improve in the decades after mine closure" (pg. 4.18-18). To support this statement, we recommend that the EIS include additional information on the magnitude of potential groundwater quality impacts at closure (including a figure that depicts geographic extent of the impacts, see our earlier comment above) and how groundwater quality is expected to improve over time.

Bulk TSF Seepage Closure Water Treatment: The DEIS states that seepage water from the bulk tailings TSF embankment would be collected and treated until treatment is no longer necessary, anticipated after closure year 50 (Section 4.18.3.1). However, the reference for this statement (Knight Piésold 2018d) indicates that TSF seepage will require treatment over the long term. We recommend that the conflicting statements regarding how long seepage water will require treatment be addressed in the EIS to clarify the Pebble Project impacts on water quality.

Adaptive Management and Monitoring at Closure: The DEIS states that "[i]f monitoring shows that water quality is not improving during the post-closure period, additional remedies would be implemented to treat the impacted groundwater, as needed." (pg 4.18-18). However, since monitoring and adaptive management plans have not been provided for review, we currently cannot determine whether the monitoring and additional remedies would be successful. We recommend that monitoring and adaptive management plans be provided so that potential environmental impacts can be more fully analyzed and explained.

Characterization of Existing Water Quality Conditions

Characterization of Existing Water Quality Variability and Trends: Approaches used in the DEIS for combining baseline water and sediment quality data over space and time do not appear to accurately represent the variability in baseline conditions. This may lead to inaccuracies in predicting the magnitude of potential impacts on ecologically important streams, wetlands, lakes, and ponds and the fishery areas they support from the Pebble Project. In the DEIS, mean surface water concentrations are presented as the means for all samples taken over all years within a given water body; the mean groundwater concentrations are presented as all samples taken over time in all wells within a given area;

and sediment concentrations are stated as being means of each sampling location's means, also appearing to be over all time. This approach does not appear to account for seasonal and spatial trends expected in surface water and sediment concentration data. Surface water concentration trends are especially important for fish because their life-cycles are dependent on time, space and water quality within the watersheds. Trends in concentration data also may exist in groundwater (especially shallow groundwater) and in sediment in deeper water bodies, but may be of a lesser magnitude than in riverine systems.

We recommend that the EIS provide an assessment (i.e., quantitative results of statistical testing) that further supports the approach taken of combining data over space and time to calculate means (for groundwater, surface water, and sediment) and demonstrates that it is a scientifically valid approach. If this approach to calculating means is not supported by the assessment results, we recommend that the affected environment analyses be revised to better represent the temporal (seasonal) and spatial water and sediment chemistry. In addition, we recommend that the environmental consequences analysis be revised to more accurately predict potential changes to those conditions. We also recommend providing a discussion of the limitations on conclusions made regarding background water and sediment quality and impacts (and associated resources) based on the data analysis and variabilities associated with the mean concentrations provided.

Because background water and sediment quality data were not collected from January through March of each year, we recommend that the EIS discuss the limitations of conclusions in the DEIS based on the limited winter data available.

Additional Comments on Water Quality Analysis

Following are additional comments and recommendations on the water quality analysis.

Water Treatment Plant Operations: We recommend the following information be added to the EIS to strengthen the analysis and disclosure of potential water quality impacts related to water treatment:

The DEIS raises the possible need for increasing the temperature of the discharge to enhance selenium removal (Section 4.18.3.1, Mine Site - Water Treatment during Operations) but does not analyze the potential need for cooling the discharge to meet surface water quality standards for temperature. If cooling will be necessary to meet temperature standards, we recommend that this be included in the EIS.

The DEIS indicates that the waste stream would be split in Step 6 for the Main Water Treatment Plant (K4.18.2.2 Main Water Treatment Plant (WTP #2), Step 6). The text discusses reverse osmosis (RO) treatment and the possibility of evaporation; however, RO treatment and evaporation are not included in any step of the process identified in the DEIS. We recommend that the EIS clarify whether RO treatment and evaporation are a 7th step in the process;

Water Treatment Plant Residuals: We recommend that the following information be added to the EIS to strengthen the analysis of potential water quality impacts related to management of the water treatment plant residuals.

The DEIS discusses the placement of the precipitated calcium sulfate solids into the pyritic TSF and explains that modeling indicates that the conditions in this TSF should prevent re-dissolution of the solids (K4.18.2.2, Main Water Treatment Plant (WTP #2), Step 5). At least one other mine in Alaska has

issues with total dissolved solids chemistry, where the conditions indicate that calcium sulfate precipitate should form but that has not actually occurred. We recommend that the EIS include monitoring and specific adaptive management plans to address how issues with precipitate would be detected and remedied as necessary.

The DEIS states that rejected selenium solids from the Main Water Treatment Plant would be placed in the Bulk TSF (Section K4.18.2.2, WTP #2, Step 6), but that selenium solids from the Open Pit Water Treatment Plant would be transferred to the pyritic TSF (Section K4.18.2.1, WTP#1, Step 7). We recommend that the EIS clarify the difference between rejected selenium solids from WTP #2 and selenium solids from WTP #1 and explain why they would be directed to two different storage facilities.

The oxygen level in the open pit is anticipated to be above 2 mg/L for all depths and closure years (DEIS Figure K4.18-13, Pages 4.18-13 and 17). Considering that as little as 0.2 mg/L implies an oxidizing environment, it seems likely that there could be oxidation of the PAG material directly underlying the water column. Dissolved ferric iron will oxidize pyritic minerals as well as dissolved oxygen (DO) faster in the presence of microorganisms that oxidize the pyrite, and the cycle will continue. Precipitation of ferric oxyhydroxides releases protons that decrease solution pH. Addition of treatment plant wastes (e.g., alkaline sludge) to the bottom part of the water column, as discussed in this section, may aid in minimizing creation of acidic conditions; however, the potential for acidic conditions to occur should be discussed in the EIS, especially since the pH input to the pit lake water quality model was not based on chemical reactions that could be occurring in the pyritic TSF over the 20 years of material storage. We recommend that the EIS include further discussion regarding disposal of water treatment residuals into the open pit, including how those residuals are expected to influence water quality to be treated over extended time and the influence of sludge volumes disposed over extended time. We also recommend discussing limitations on data and concluding statements from assuming a "fully mixed pit lake during the four closure phases" when PitMod predicts that there would be thermal and chemical stratification after closure years 25-30, seasonal extension of well-oxygenated waters would reach a depth of about 50 feet (K4.18-10), and that oxic conditions also would exist in the lowermost 130 feet of the pit.

<u>Fugitive Dust Impacts on Water Quality</u>: The fugitive dust deposition calculations appear to underestimate the impacts to streams, wetlands, lakes, and ponds. The DEIS states that "[t]he equation used [in the analysis] conservatively assumes all of the metals from air deposition partition to sediment" (pg. K4.18-57). While we concur that this approach is conservative from the perspective of sediment concentrations, it results in an underestimation of surface water concentrations. Based on our understanding of the calculations, the metals deposited in water partition further into the sediment and then a small fraction of that concentration leaches back into the water from the sediment. Given the small particle sizes associated with fugitive dust deposition, we would anticipate that most of these particles could be entrained within the water column and would not immediately deposit to the sediment. Furthermore, we would also expect some metals partitioning directly from the entrained particles into the dissolved phase in the water. We recommend a more conservative approach be taken in the EIS impacts analysis from the perspective of water concentrations, i.e., if 100 percent of the fugitive dust deposited remains in surface water rather than partition into the sediment.

In addition, the DEIS (Section 4.18.3.1 Mine Site - Effects from Deposition of Fugitive Dust) states that the expected increase in the concentration of metals in surface water would not result in any exceedances of the most stringent water quality standards. Because this statement does not acknowledge that, based on baseline water quality monitoring, some of the waterbodies in the project area currently

exceed the most stringent criteria for metals concentrations more information is needed. We recommend that the analysis of fugitive dust impact on water quality consider the existing water quality conditions of potentially impacted waterbodies and that the EIS include locations and waterbodies where fugitive dust impacts will result in exceedances of water quality standards, if any. In addition, see our earlier water quality comment related to consideration of the additive impacts of selenium in fugitive dust and treated water discharges.

Impacts Due to Road Construction: The DEIS (Pg. 4.18-21) states that "[t]he extent of effects during road construction would likely be limited to stream crossing locations within the construction right-of-way (ROW)." We recommend providing supporting analysis for this conclusion.

Impacts Due to TSS From Ferry Operation: The DEIS (Pg. 4.18-21) states that " . . . if fine bottom sediments were resuspended by ferry operations, it is expected that TSS concentrations would be expected to return to background levels within a short distance (less than 100 feet) from the ferry." We recommend providing additional information in the EIS to support this statement.

Impacts to Water Quality at Port Locations: The DEIS Section 4.18.4.3, Diamond Point Port, discusses the effect of marine water from the dredged material seeping into groundwater from the initial dredging when at least half of the dredged material would be used in the causeway. During future dredging events all the dredged material would be placed in the disposal area as it will no longer be needed for causeway construction. We recommend that the EIS further analyze potential groundwater impacts from disposal of material from future maintenance dredging.

DEIS Section 4.18.3.3, Amakdedori Port - Substrate/Sediment Quality, states that runoff would be treated and discharged to Amakdedori Creek, while Section 2.2.2.3, Amakdedori Port and Lightering Locations – Water Management, states that the runoff would be treated and discharged through an outfall at the end of the dock, presumably to Cook Inlet (more specifically, Kamishak Bay). We recommend that this apparent discrepancy in runoff discharge locations be clarified or corrected in the EIS.

DEIS Section 4.18.3.3, Amakdedori Port - Substrate/Sediment Quality, states that "[p]otential contaminants from marine vessels accessing Amakdedori Port would be diluted and flushed into the North Pacific Ocean and would not be expected to contribute a negligible amount of contamination to existing low background levels" (4.18-25). However, Section 3.18.3.3, Substrate/Sediment Quality, describes Kamishak Bay as a natural depositional area for hydrocarbons. Based on this information, while the rest of Cook Inlet is well flushed by high tidal exchanges, the same may not be true for Kamishak Bay. We recommend that the apparent discrepancy in the characterization of Kamishak Bay between Chapters 3 and 4 be addressed or clarified, and that the EIS further analyze the potential for hydrocarbon impacts in Kamishak Bay.

Impacts of Future Potential Changes in Climate: The modeling of water quality impacts was performed under a range of historic climate conditions, using long-term historical air temperature trends, but predictions are not included regarding future climate scenarios. The DEIS states that there is no long-term data for water temperatures, which influences dissolution of minerals, and discusses that there is an expected increase in trends. Currently, the DEIS does not address how any changes in air temperature may influence changes in water temperature (or whether they are relatable) or how changes in climate may affect precipitation patterns and subsequent influences on water chemistry. We recommend that the EIS include a discussion of how the water quality impacts might change under different climate

scenarios, including an explanation of the link between air temperature and water temperature. We recommend that the analysis address how water quality (and quantity, with respect to size of storage ponds and the amount of water released to streams) will change with projected temperature and precipitation changes and the influence of these changes on resources.

Additional Comments on Geochemistry: We recommend the additional technical comments on geochemistry below be addressed in the EIS.

The statements made in the DEIS regarding the tailings material suggest that the potential for metal leaching and acid generation is lower than is indicated in some of the supporting documents. For example, Chapter 3.18 states that, "Geochemical testing of 64 tailings samples indicates that the most volumetrically abundant product, bulk tailings, which would be produced under most of the processing approaches being considered, typically contains low to moderate total sulfur" (pg. 3.18-4). However, Table K3.18-3 shows that the tailings have an average NP/AP of 0.29. A ratio this low suggests that the tailings would be acid generating (Ch. 3.18 states that NP/AP values of less than 1.4 are potentially acid generating). Given the very low NP/AP value in Table K3.18-3, the geochemical ABA testing results show the tailings to be acid generating. We recommend that this be reflected in the main text of Chapter 3.18.

Chapter 3.18 of the DEIS states that "[d]ata analysis from the various geochemical tests performed yielded consistent results. Leaching data from humidity cell tests, barrel tests, and shake flask tests performed on samples collected in both the PWZ and PEZ were used to develop geochemical source terms for predictive water quality (SRK 2018c, 2018f). Additional information regarding how the data were used in water quality modeling is provided in Section 4.18, Water and Sediment Quality" (pg. 3.18-4). The reference SRK 2018c, Geotechnical Stability Assessment of the Pebble West Pit Memorandum, does not appear to contain information needed to support these statements. Similarly, SRK 2018f, Response to PLP Action Item from Water-Focused Technical Meeting, provides information on how the data from the east and west zones are similar, but does not provide supporting analysis to directly address the statement that there were consistent results between the humidity cell tests, the barrel tests, and the shake flask tests. We recommend that Section 4.18 of the EIS provide a summary of the information in the reference documents and that the EIS provide a statistical evaluation of the release rates from these different tests showing that there were no significant differences between the various geochemical test methods.

The second sentence in the quote above suggests that data from all three methods were used to develop the source terms used to predict water quality. Information from other supporting documents suggests that only the HCT data was used for this purpose. We recommend that this be clarified in the EIS; if the data were all used to develop the geochemical source terms, we also recommend including a discussion regarding how this data was combined/averaged in the EIS.

Chapter 3.18 states that "[b]ulk tailings can be categorized as non-PAG if the total sulfur remains below 0.2 percent" (pg. 3.18-4). However, this information is not supported by data presented in Table 11-29 in the reference document, PLP 2018a. Table 11-29 presents the NP/AP values and the percent total sulfur for different samples. Earlier in the DEIS, PAG is defined by a NP/AP ratio of 1.4 and there are several examples where the NP/AP is below this level and yet the %S is lower than 0.2. For example, sample number LCT-35 had a %S of 0.13 and an NP/AP ratio of 1.2; LCT-31 had a %S of 0.15 and a NP/AP of 1.2; LCT-42 had %S of 0.16 and NP/AP of 1.4; KS-LCT1 had %S of 0.15 and NP/AP of 1.4; LCT 50 had a %S of 0.18 and NP/AP of 0.3; and LCT 58 had %S of 0.18 and NP/AP of 0.4. While these

examples may be exceptions to the general trend of non-PAG generally having a low %S, we recommend that it is important that the EIS acknowledge that exceptions to this general trend exist.

In addition, PLP 2018a states, "Figure 11-35 shows the NP/AP ratio plotted as a function of sample sulfide content. As observed previously (EBD, 2010), sulfide content appears a strong control on NP/AP – where NP/AP values below 2 are coincident with sulfide contents above 0.2%." However, this information is reported in the DEIS with sulfide changed to total sulfur. While sulfide is often a major percentage of the total sulfur, these two measurements are not equivalent, due to the presence of sulfate. The total sulfur numbers will be larger than the sulfide numbers, consequently, there is a potential to underpredict water quality impacts, and we recommend that this be addressed in the EIS.

Chapter 3.18 states that, "Element leaching from the rougher tailings occurred at low rates, and unfiltered process supernatants were found to contain low levels of potential constituents relative to water quality standards" (pg. 3.18-4). We recommend that the EIS provide information to clarify whether this statement is referring to the analysis of fresh, aged, or the combination of both supernatants. The reference, SRK 2011a, shows that the copper concentrations increased by an order of magnitude between the fresh and the aged supernatants. For example, when comparing fresh and aged supernatants, pg. 11-59 of SRK2011a states that cooper concentrations increased from 2 to 17 µg/L for one sample, and from 6 to 16 µg/L for another sample. Presumably the aged supernatant results are more representative of actual conditions that will occur in the field. Additionally, based on the values presented in Table K3.18-1, the copper criterion is 2.19 µg/L, so both the fresh and aged samples appear to exceed this criterion. Therefore, we recommend that the discussion of the supernatant concentrations focus on the aged analysis instead of the fresh analysis

Figure K3.18-2: We recommend that the EIS provide additional context for the figure displaying neutralizing potential as a function of acid generating potential, including the type of tailings for the previous data (2004, 2005, and 2008) and the type of tailings examined in the barrel test in 2012. Tailings in the EIS are discussed in terms of bulk and pyritic; bulk tailings are described as non-PAG and pyritic tailings are described as PAG. It appears that a majority of 2011 samples of rougher tailings have a NP/AP < 1, which would suggest they are PAG. We recommend clarifying Figure K3.18-2 and the associated text to specify data representing the mine material that will be stored in the bulk TSF and data representing what will be stored in the pyritic TSF.

Additional Comments Related to Existing Water Quality:

Description of Existing Water Quality Exceedances: The DEIS states that "[w]ater quality data occasionally exceeded the maximum criteria for concentrations of various trace elements in some individual sample measurements" (pg. 3.18-7). We recommend that the EIS provide information on the specific locations where criteria is exceeded to strengthen the characterization of the affected environment. We recommend that hydrological conditions associated with the exceedances; for example, whether they mostly occur during baseflow or high flow conditions, also be provided. The hydrological conditions are an important factor affecting metal/metalloid concentrations.
Transportation Corridor Groundwater Quality: Chapter 3.18 (pg. 3.18-2) states that "[g]roundwater quality beneath the proposed 84-mile transportation corridor under Alternative 1 and the additional segments under Alternatives 2 and 3 can be characterized as similar to that of the mine site and port" (pg. 3.18-20). No supporting data is provided in the DEIS to support this statement, and the DEIS later states that the northern access road crosses a variety of surficial deposits, which can influence

groundwater quality and characteristics. We recommend that the EIS provide additional information to support characterization of groundwater quality beneath the transportation corridor for all alternatives.

Figure 3.18-1: The figure displaying surface water quality sampling locations appears to be missing many seep sites that are identified in Figures 9.1-4 and 9.1-5 of the Environmental Baseline Document. Further, the stream sites shown in Figure 3.18-1 do not match the stream sites shown in Figure 9.1-3 in the EBD (e.g., NK100B does not appear in the same location, NK100D in not included). We recommend verifying and correcting the information in Figure 3.18-1 to provide a more accurate disclosure of existing water quality conditions.

Pg. 3.18-8: The DEIS states that, "Recorded pH values ranged from 3.31 to 9.33 with the lowest pH recorded in the NFK and the highest recorded in UTC. The frequency of this trend in seeps was at least double that of streams, depending on the watershed." We recommend that the EIS provide additional information to clarify the trend being discussed.

Pg. 3.18-8: The DEIS text states that mean dissolved oxygen concentrations "ranged from 10.2 to 10.5 mg/L;" however, according to Tables K3.18-7 through K3.18-9, mean DO concentrations did not exceed 9.89 in the NFK, SFK, or UTC watersheds. We recommend that the dissolved oxygen concentrations be verified and corrected, or further explained, as appropriate.

Tables K3.18-8 and K3.18-9: The "Range of Detects" for dissolved oxygen in the tables summarizing surface water for the mine site provides a maximum of 18.2 and 18.6 mg/l, respectively. These values appear higher than saturation concentrations, even at zero degrees. We recommend verifying the values and correcting the data assessment and discussions if they are anomalous.

Table K3.18-7 through Table K3.18-12: Appendix K3.18 states that, "Table K3.18-7 through Table K3.18-12 provide the range of detected results, along with the mean and standard deviation" (pg. K3.18-42). The standard deviation is not reported in these tables and we therefore recommend that it be added to the tables. We recommend that the EIS discuss what data are and are not included and why, including why the numbers of samples reported for total and dissolved concentrations vary for many of the elements.

Background surface water quality: We recommend explaining the selection of sites NK119A and SK100F for characterizing background water quality. NF119A is located within the mine footprint, but SK100F is located downstream from Frying Pan Lake, which is outside of the mine footprint. We recommend clarifying in the EIS how these two sites selected for characterizing background will achieve the stated goal of providing predicted concentrations from sources "at the mine site that would be captured onsite, such as waste rock, pit wall runoff, railings, existing streams, and groundwater", since one of them is not located within the mine site.

Impacts on Sediment Quality

<u>Metals Accumulation</u>: The DEIS states that chemical components in water (such as metals and sulfate) would be absorbed by sediment or adsorbed onto sediment surfaces, and that conversely sediment would be expected to retain chemical constituents and slowly release them back into water. We recommend including a discussion of this cycle of metals accumulation with enough information to clarify the magnitude and extent of these changes, particularly for metals, such as selenium and mercury, that tend to accumulate in sediments and adversely impact sediment and water quality.

Sediment Monitoring for Operational Impacts: The DEIS states that trace elements were detected in the baseline sediment samples, and the highest detected concentrations of arsenic, chromium, copper, and nickel exceeded concentrations that may have an adverse effect on benthic organisms, both the threshold effects level and higher probable effects level (PEL). The mean concentration of arsenic also exceeded the threshold effects level across the study area (Section 3.18.1.3, Substrate/Sediment Quality). We recommend that a monitoring plan be provided in the EIS that explains how these sediment baseline concentrations will be utilized when compared to operational and closure monitoring data to assess whether sediments have been impacted by the mine.

Sediment Quality at Port Locations: The DEIS uses NOAA's freshwater sediment quality guidelines for comparison to baseline freshwater sediment quality information. In the absence of sediment quality guidelines for the State of Alaska, the NOAA values appear to be an appropriately conservative measure to use here and in future freshwater sediment quality monitoring. We recommend also considering Washington State's freshwater standards for selenium (11,000 ppb) and silver (570 ppb), which can be integrated into future sediment monitoring comparisons.

We recommend that marine sediment quality comparison values be provided. The schedule in Geoengineers 2018b indicates that additional sediment fieldwork was to be conducted in 2018 near the marine port proposals. We recommend that sediment characterization from the port locations (especially from Diamond Point Port) be provided in the EIS, as an important component of characterizing the existing environment. We recommend that the EIS also provide appropriate marine sediment quality guidelines, such as those published by NOAA or Washington State. Any future marine dredging and disposal would require additional sediment physical and chemical characterization/review specific to the proposed project at that time.

WETLANDS, AND OTHER WATERS / SPECIAL AQUATIC SITES

The Pebble Project Draft EIS (DEIS) discloses the permanent loss of approximately 3,443 acres of wetlands, 81 miles (50 acres) of stream, 11 acres of marine waters, and 55 acres of lakes and ponds. There are additional temporary and indirect impacts. The key issues regarding impacts to streams, wetlands, lakes, and ponds is that the DEIS likely underestimates the extent, magnitude, and permanence of the adverse effects of the Pebble Project's discharges of dredged or fill material to streams, wetlands, lakes, ponds, and marine waters, and the fisheries resources they support. The DEIS does not fully identify and characterize existing aquatic resources and wetland functions to establish the environmental baseline for the analysis, because the analysis area is limited and the DEIS does not use salient available site-specific data. In addition, the analysis does not fully assess secondary/indirect effects, which is important to compare alternatives and analyze project impacts. These comments and recommendations are described below. Our letter on the CWA 404 Public Notice (see Sections V.A. and V.B.) also reflects these issues and discusses the CWA 404(b)(1) Guidelines.

Baseline Characterization - Defining Extent of Potentially Affected Aquatic Resources

Wetland Mapping: The DEIS (3.22-4-5) identifies that all Action Alternatives include areas that lack field-verified wetland mapping. Action Alternatives 2 and 3 include approximately 3,126 acres where existing National Wetland Inventory (NWI) coverage was used to map wetlands instead of field-verified wetland mapping. In addition, Action Alternative 1 includes approximately 1,300 acres where satellite data was used to map wetlands at 100-meter resolution instead of field-verified wetland mapping. Based

on the EPA's review of the preliminary jurisdictional determination, NWI coverage and satellite data substantially under-identify wetland area relative to field-verified mapping. In addition, the current disparity in the wetland mapping for different alternatives makes it difficult to compare the wetland impacts between the alternatives. According to the Corps, supplemental wetland mapping to fill these gaps is planned for the 2019 field season and this information would be included in the final EIS. Where high resolution information is not currently available, the EPA supports the Corps' decision to conduct additional data collection as greater precision mapping is necessary to accurately identify the impacts in light of the significant and complex nature of the discharge activities in this case.

Geographic Extent of Analysis: The DEIS defines an analysis area that is a fixed width area around the mine site. The DEIS analyzes impacts within this area and does not analyze impacts that are outside it. Section 230.11(h) requires an evaluation of the secondary effects of the discharges of dredged or fill material on the aquatic ecosystem, which include effects of the proposed discharge on the downstream ecosystem. However, the analysis area in the DEIS excludes areas downstream of the mine site where secondary/indirect impacts would occur. In addition, sections 230.11(b), (e), and (g) require an evaluation of the cumulative effects of the discharge of dredged or fill material on the aquatic ecosystem. However, the analysis area in the DEIS does not include the headwaters of UTC where future mining expansion would occur (i.e., the expanded mine scenario evaluated as part of the cumulative effects analysis in the DEIS). The aquatic resources in these additional areas were mapped at high resolution and field-verified between 2004 and 2008 during the collection of the environmental baseline data.[4] We recommend that the Corps use complete and accurate mapping of the extent of potentially affected aquatic resources (including direct, secondary/indirect and cumulative effects), taking advantage of available field-verified aquatic resource mapping information. Alternatively, the Corps should explain why its existing approach is sufficient in light of the significance and complexity of the discharge activities associated with this project.

Stream Mapping: Regarding streams, the DEIS relies on the National Hydrography Dataset (NHD) mapping of stream networks to identify the streams that will potentially be impacted by the proposed project. The NHD does not capture all stream courses and may underestimate channel sinuosity, resulting in underestimates of affected stream length. We recommend that the EIS acknowledge uncertainties in the use of NHD and, to the extent possible, provide an estimate of the additional stream length for reaches that are not captured by the NHD.

In the DEIS, maps that depict the same areas show different stream channels (Figures 4.16-1, 4.22-2, 4.24-1, relative to NHD coverages for the same area). The DEIS does not explain these discrepancies. We recommend that the EIS: 1) use a consistent, thorough, and transparent "baseline" estimate of stream channel extent throughout the analysis area (i.e., for the mine site, transportation corridor, and all other project components); and 2) ensure that these stream channels are visible on all maps.

Assessing Impacts to Functions Provided by Potentially Affected Aquatic Resources

As discussed below, the DEIS does not assess the functions provided by the potentially affected streams, wetlands, lakes, ponds, and marine waters or the impacts to those functions in sufficient detail to evaluate impacts.

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[4] The 2004-2008 mapping effort assessed over 100,000 acres just in the proposed mine area. The environmental baseline mapping was augmented in 2013 and 2017 to map the newly-proposed southern access route and the Amakdedori Creek and Diamond Point port sites.

Available High-Resolution Data: The DEIS identifies the aquatic resources that will potentially be impacted by the proposed project, including lakes, ponds, and streams, using eight condensed classes. Earlier mapping work conducted by the project proponent used 27 enhanced NWI classes of aquatic resources, including for lakes, ponds, and streams. This kind of enhanced NWI mapping and differentiation among the aquatic resources allows for more accurate assessments of the functions that the potentially affected aquatic resources perform as compared to an approach that uses more general, condensed classed like those used in the DEIS.[5] The DEIS (Section 3.22.1) does not rely on this more detailed aquatic resource data and does not explain why the greater precision information already existing in the GIS database was not used for analysis. We recommend that the Corps use the greater precision information that was collected to determine the nature and degree of effect that the proposed project discharge will have on the structure and function of the aquatic ecosystem and organisms in light of the significance and complexity of the discharge activities associated with this project. Alternatively, the Corps should explain why this more detailed information was not used and fully explain how a condensed approach allows for a complete and accurate assessment of the functions provided by the resources at issue.

Wetlands Functions: For wetlands, the Corps provides what it calls "a qualitative overview of wetland functions in the EIS analysis area." (pg 3.22-7). This qualitative overview does not describe the level at which potentially affected wetlands are currently performing each function. This information is important to determine the nature and degree of effect that the proposed discharge will have…on the structure and function of the aquatic ecosystem. In this case, not only are the functional assessment methods available but extensive data was collected, particularly at the mine site, to apply the methods.[6] We recommend that the EIS characterize the level at which potentially affected wetlands are currently performing each function, taking advantage of available site-specific functional assessment data and where necessary supplementing that data. Alternatively, we recommend that the DEIS explain why its "qualitative overview" of wetland functions is sufficient to assess the nature and degree of effect that the proposed discharge will have on the structure and function of the aquatic ecosystem in light of the significance and complexity of the discharge activities associated with this project.

Scrub and herbaceous wetlands[7] constitute most of the wetland losses and degradation anticipated by the proposed project.[8] However, the DEIS does not include the full set of functions provided by these two types of wetlands. Scrub and herbaceous wetlands, depending on their position in the landscape and water regime, provide high-quality habitat for numerous fish species and contribute water, nutrients, organic material, macroinvertebrates, algae, and bacteria downstream to higher-order streams in the

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[5] The additional aquatic resource classes provided by the enhanced NWI reduce within-class variability and make attributing function easier and more meaningful, supporting a more precise and accurate functional assessment.

[6] During the 2004-2008 mapping/delineation work, wetlands were identified by both enhanced NWI and Hyrdogeomorphic (HGM) class, and data was collected to assess wetland function using the Rapid Procedure for Assessing Wetland Functional Capacity, Based on Hydrogeomorphic Classification (Magee, 1998). The performance of eight wetland functions was quantitatively assessed. These are: 1) modification of ground water discharge; 2) modification of ground water recharge; 3) storm and flood water storage; 4) modification of stream flow; 5) modification of water quality; 6) export of detritus; 7) contribution to abundance and diversity of wetland vegetation; and 8) contribution to abundance and diversity of wetland fauna. Two hundred and twenty-eight wetland functional assessments were conducted in the mine area during the 2004 field season alone. The ENWI water regime modifiers and functional data from the earlier mapping were not used for attributing function and evaluating project-related functional loss and is not referenced in the DEIS.

[7] Classified using NWI.

[8] This comment also applies to wetlands classified as slope wetlands under the HGM classification because there is extensive overlap between HGM slope wetlands and the wetlands classified as scrub or herbaceous under NWI.

watershed. They also moderate groundwater discharge and surface and subsurface flows to other wetlands and support stream base flows, which all act to support fish habitat, including thermally diverse habitats. The scrub and herbaceous wetlands in the NFK, SFK, and UTC watersheds preform these functions due to the high level of hydrologic connection between streams, wetlands, lakes, and ponds in the area. The DEIS does not attribute these functions to scrub and herbaceous wetlands potentially affected by this project. Without this information, the Corps record would underestimate the anticipated aquatic resource functional losses. We recommend that the EIS characterize the full array of functions currently performed by the potentially affected wetlands. Alternatively, the Corps should explain why its existing description of the potentially affected wetlands is sufficient to analyze the nature and degree of effect that the proposed project discharge will have on the structure and function of the aquatic ecosystem and organisms in light of the significance and complexity of the discharge activities associated with this project.

Regionally Important Wetlands: The DEIS (pg. 3.22-8) identifies certain wetlands as "regionally important"[9] based on a few general characteristics including whether they provide habitat for regionally important fish (without identification of any specific fish species). The DEIS appears to give more weight to losses of aquatic resources that it identifies as "regionally important." This list of regionally important wetlands appears to omit the wetland types that are estimated to sustain the greatest level of project induced impacts (i.e., scrub and herbaceous wetlands).[10] In addition, due to the strong hydrologic and ecologic connection, virtually all wetlands in the analysis area appear to meet the Corps' definition of a "regionally important" wetland because they, either directly or indirectly, support habitat for anadromous and resident fish through flow contribution or moderation, water quality benefit, or organic matter or nutrient contribution. Similarly, the DEIS does not explicitly identify streams as "regionally important," although all fish-bearing streams (and their tributaries), lakes, and ponds provide habitat support for anadromous and resident fish species. As a result, the DEIS' approach to filter resources based on a determination of whether they are "regionally important" does not account for the full functions of these resources and results in an underestimation of anticipated aquatic resource functional losses. The EPA recommends that the DEIS not use this "regionally important" approach because the DEIS does not explain how the few characteristics it considered support a conclusion that some aquatic resources are regionally important, and others are not. In addition, the DEIS does not explain how its criteria as applied results in identifying resources that are more "important" than others. The EPA recommends that the Corps conduct a detailed analysis of the functions provided by each of the aquatic resource types as a basis for determining the value of what would be lost due to impacts from the project in light of the significance and complexity of the discharge activities associated with this project.

Streams, Lakes, and Ponds Functions: No functions are attributed to the specific stream reaches, lakes, or ponds that would be lost or degraded by the project. The DEIS does not identify what functions these specific aquatic resources perform or the degree to which they are currently performing each function. This information is important in determining the nature and extent of impacts on the structure and function of the aquatic ecosystem and organisms. We recommend that the Corps characterize the full array of functions currently performed by the potentially affected streams, lakes, and ponds as well as the degree to which they are currently performing each function. Alternatively, we recommend that the EIS explain why the current approach is sufficient in light of the significance and complexity of the

[9] This is not a term relevant to compliance with NEPA or the Guidelines, and it is unclear how and why the Corps is making this determination.
[10] As previously noted, many of these wetlands were also classified as slope wetlands using HGM.

discharge activities associated with this project. Characterization of fish habitat functions and potential impacts to those functions is discussed in more detail below.

Impacts to Aquatic Resources Functions: The DEIS does not characterize how performance of each function would change as a result of the direct, secondary/indirect, and cumulative effects of the discharge of dredged or fill material associated with the project. Instead, the DEIS only includes general statements such as "[e]xcavation, filling, and clearing of wetlands and other waters would alter or remove their capacity to provide hydrologic, biogeochemical, and biological functions" (pg. 4.22-8). We recommend that the EIS characterize the degree to which each of the functions provided by each of the potentially affected aquatic resources will change as a result of the direct, secondary/indirect, and cumulative effects of the project. Alternatively, we recommend that the EIS explain why the current general approach is sufficient in light of the significance and complexity of the discharge activities associated with this project.

Secondary/Indirect Effects: The scale and location of the direct impacts associated with the Pebble Project's discharges of dredged or fill material likely will result in numerous secondary/indirect effects. The DEIS (pg. 4.22-4) identifies seven general types of secondary/indirect effects associated with the project: disruption of wetland hydrology; conversion of wetland type; habitat degradation downstream of the mine site; fragmentation of habitats; water quality and quantity changes; erosion and sedimentation; and fugitive dust. However, the DEIS estimates the acreage of wetlands and other waters potentially impacted by three of these types of secondary/indirect effects: habitat fragmentation, fugitive dust, and dewatering. We recommend that the Corps estimate the geographic extent (i.e., area, and for impacts to streams, linear miles also) of all of the types of secondary/indirect effects identified in the DEIS. We recommend that this include the estimated amount (in linear miles and area) of habitat degradation downstream of the mine site, and its potential implications for fish (discussed in more detail in Fish Values comments, below). Alternatively, the EIS explain why the current evaluation of the secondary/indirect effects of the proposed discharges on the aquatic ecosystem is sufficient in light of the significance and complexity of the discharge activities associated with this project.

The attribution of fugitive dust impacts is based on a fixed-width buffer rather than the dust dispersion model developed for the project, which would likely be more accurate than an assumed buffer. We recommend that the EIS explain which method is expected to provide more accurate results for determining the geographic extent of fugitive dust impacts on aquatic resources and utilize that method.

The DEIS indicates that there is uncertainty regarding the extent of the cone of depression and the predicted changes to groundwater and surface water hydrology (pg. 2.2.2.1-2-16 and 4.17.3). Thus, the volume of water produced during pit dewatering could be greater than predicted by the groundwater model, and the capture zone and zone of influence could be larger (4.17.3.1) meaning that additional aquatic resources could be impacted by the groundwater drawdown. We recommend that the EIS explain the uncertainty in the estimates of the geographic extent of dewatering impacts.

Characterization of Impacts: The DEIS does not fully identify the severity or significance of impacts to aquatic resources. For example, the DEIS (4.22-11) identifies that roughly 12 percent of the shrub wetlands and 17 percent of all stream channel length in the 171,000-acre watershed would be directly impacted (i.e., permanently lost), but it does not identify the loss of functions and the severity or significance for those effects (i.e., the relative importance of that loss). Similarly, the DEIS discloses that the proposed natural gas pipeline may impact two weathervane scallop beds, potentially affecting the sustainability of the Kamishak Bay weathervane scallop fishery. The DEIS also discloses that the

Pacific herring sac roe fishery in Kamishak Bay could experience direct or cumulative effects. The specific ecological or economic consequences of these impacts are not evaluated. We recommend that the EIS identify the nature and degree of effect of the proposed project on the aquatic ecosystem, including the severity or significance of those effects.

The DEIS considers impacts to streams, wetlands, lakes, and ponds in terms of Hydrological Unit Code (HUC)-10 watersheds, whereas impacts to fish resources (discussed in more detail below) are considered at a different scale (i.e., the NFK, SFK, and UTC watersheds), even though streams, wetlands, lakes, ponds, and fish are highly inter-related aquatic resources. We recommend that the EIS evaluate effects to streams, wetlands, lakes, ponds and fish at the same scale (i.e., the NFK, SFK, and UTC watersheds). Alternatively, we recommend that the EIS explain why it is appropriate to use different evaluation scales for these inter-related aquatic resources.

FISH VALUES

The physical, chemical, and biological impacts on ecologically important streams, wetlands, lakes, and ponds and the fishery areas they support should be more fully addressed in the EIS. The EPA recommends significant improvements to: habitat characterization, assessment, quantification, and spatial referencing; assessment of linkages between the loss and/or degradation of habitat and impacts to fish species and life stages (i.e., incubating eggs, spawning fish, and rearing juveniles); groundwater and surface water flow characterization at a scale that is more relevant to fish and fish habitat; and analysis of the potential population-level effects and effects on genetic diversity in the context of the Bristol Bay salmon portfolio. Our detailed comments and recommendations are provided in the following subsections and include comments on the draft Essential Fish Habitat (EFH) Assessment (Appendix I) since it is a supporting document to the DEIS. Our letter on the CWA 404 Public Notice (see Section V.C. of the letter) also reflects these comments and discusses the CWA 404(b)(1) Guidelines.

Fish Habitat

The abundance and distribution of different fish species are dictated by availability of the diverse, ecologically important habitats—wetlands, streams, lakes, ponds, off-channel areas, and other habitat types—that each species requires. The sufficiency, spatial arrangement, and proximity of the habitats each species requires throughout its life cycle (e.g., for spawning, rearing, overwintering, feeding) are key factors determining productivity and sustainability of fish populations. For this reason, the Corps should analyze how the project will affect both the amount and the accessibility of the full complement of habitats that each fish species requires to complete their life histories. If spawning and rearing habitats no longer exist at sufficient levels (in terms of quantity or quality), or no longer exist in proximity to each other, the abundance, productivity, and sustainability of fish populations will be compromised. These habitats would need to remain both sufficiently represented and connected, throughout the project area, in order to sustain resiliency and persistence of fish populations.

Habitat Characterization: Table 3.24-1 presents different types of habitats: mainstem reach, riffle, run/glide, pool, beaver pond, and other off-channel habitat types. The DEIS does not explain or provide evidence to support (1) how these habitats were selected and sampled; (2) whether these habitats represent all fish habitats that may be impacted by the project; and (3) how and when these habitats are used by fish [e.g., in terms of species, season, and life history stage (e.g., spawning vs. rearing vs. overwintering habitats)]. The DEIS also does not explain how this habitat information is used to evaluate effects of the project on fish (i.e., DEIS Section 4.24). We recommend that the EIS include

information regarding how and when fish habitats were defined, identified, and sampled; whether they represent all relevant fish habitats in the project area; how and when different fish species use these (and any other) habitats; and how these habitats will be affected by this project. Alternatively, we recommend that the EIS explain why its existing description of fish habitats is sufficient in light of the significance and complexity of the discharge activities associated with this project.

The Draft EFH Assessment discloses that areas of spawning, migration, and rearing are delineated based on the available ADF&G Anadromous Waters Catalog and observations PLP made during project studies. However, it does not explain the repeatable process framework by which habitats were identified or characterized. Representative habitat characterization provides the foundation on which interrelated studies (e.g., fish distribution and abundance studies) can be overlain. A consistent project framework that clearly states criteria used to classify or characterize different habitat types should be a precursor to quantifying pre-existing and post-project fish habitat. We recommend that the EIS include additional information used to support baseline habitat characterizations, including references to baseline habitat studies and the framework used to characterize fish habitats. Alternatively, we recommend that the EIS explain why its existing analysis of fish habitat is sufficient in light of the significance and complexity of the discharge activities associated with this project.

The DEIS does not provide a comprehensive analysis of environmental factors associated with distributions and abundances of fish species throughout the project area watersheds, which is needed to evaluate project-related changes in fish habitat. We recommend that the Corps ensure its analysis is comprehensive, which would include summaries of seasonal fish species' distributions and abundances (with uncertainty estimates), associated environmental conditions, and an assessment of factors potentially limiting distributions and abundances of fish species found within the project area watersheds. We recommend that the EIS discuss how habitat was assessed at both sites where fish were observed and sites where fish were not observed, to evaluate what characteristics (e.g., groundwater upwelling or downwelling, water temperature) were significant predictors of fish occurrence. We recommend that the EIS also include areas that were assessed as overwintering habitat. Inclusion of such information will help validate and support inferred relationships between fish distribution, abundance, and habitat selection. Alternatively, we recommend that the Corps explain why its existing analysis of fish habitat and relevant environmental factors is sufficient in light of the significance and complexity of the discharge activities associated with this project.

The DEIS (pg 4.24-8) states that, "[s]pecies diversity and abundance data indicate there is sufficient available habitat for relocation without impacts to existing populations." The DEIS does not appear to provide support for this statement, and it does not present information on how available relocation habitats were assessed or what constitutes fish habitat. We recommend that the EIS explain what is meant by "sufficient available habitat that would allow for relocation without impacts to existing populations" and provide information and analyses to support this statement. Alternatively, we recommend that the Corps explain why its existing assessment of fish habitat and population-level effects of the project is sufficient in light of the significance and complexity of the discharge activities associated with this project.

Table 4.24-2, entitled "Average precipitation year spawning habitat for all streams and species in the mine site area pre-mine, during operations, and post-closure," does not include all species documented to occur at the mine site area.[11] Values are reported in terms of stream area for all watersheds combined,

[11] Woody and O'Neal 2010.

but both stream area and stream length and breakdowns by watershed are necessary for evaluation purposes. We recommend that the table be revised to include (1) all anadromous and resident fish species (including lamprey) documented to occur in the project area watersheds and (2) values in terms of stream miles in each of the three project area watersheds, in addition to stream acreage. Alternatively, the Corps should explain why its existing analysis is sufficient.

Habitat Function and Connectivity: The DEIS and the Draft EFH Assessment do not analyze habitat function (i.e., how fish species are using the different habitats at risk from project impacts during all life stages). Fish species and populations use different habitats for different functions (e.g., spawning, egg incubation, rearing, refugia, feeding, overwintering, and migration), and this habitat use varies both seasonally and from year to year.[12] We recommend that the EIS describe fish habitat functions and their spatial and temporal variability and explain the consequences of project-related changes to each of those habitats in terms of the different habitat functions (i.e., spawning, egg incubation, rearing, refugia, feeding, overwintering, and migration). This would allow for estimation of the amount of habitat loss (in acres and linear miles) related to different habitat functions, for different fish species. Alternatively, we recommend that the Corps explain why its existing analysis is sufficient in light of the significance and complexity of the discharge activities associated with this project.

The DEIS does not analyze the spatial arrangement or connectivity of different habitat types used by anadromous and resident fish species throughout their life cycles within the project area. We recommend that the EIS analyze the spatial arrangement and connectivity of different fish habitats or explain why the existing analysis is sufficient in light of the significance and complexity of the discharge activities associated with this project.

The DEIS (pg. 4.24-6) states that "[f]ree passage of resident and anadromous fish may be temporarily interrupted but would continue unimpeded after construction is complete. Habitat at the immediate location of culverts would be altered, but fish would continue to use the streams." The DEIS does not cite evidence to support these statements. We recommend that the EIS include further analysis and explanation to support these statements, or explain why its existing statement is sufficient in light of the significance and complexity of the discharge activities associated with this project.

Habitat Quantification: The DEIS and Draft EFH Assessment lack basic habitat quantifications for streams, lakes, ponds, and marine habitats: stream loss of channel length is not quantified by linear feet and/or miles; habitats assessed to be spawning, incubation, rearing, overwintering, and feeding areas are not quantified in acreage; migratory habitats are not quantified as linear stream miles and acreage; and, there is not sufficient quantification of habitat types and fish usage. We recommend that EIS quantify the geographic extent of potentially affected fish habitats, or explain why its existing analysis is sufficient in light of the significance and complexity of the discharge activities associated with this project. Specific recommendations are included for each of the instances listed below:

1. The Draft EFH Assessment (Table 5-1 p. 68) presents a summary of essential fish habitat for managed fish species that will be lost/destroyed during mine site development. We recommend including a table which quantifies potential habitat losses for all species (including resident and non-managed anadromous species) found in the project impact area. This information will enable

[12] Brennan et al. 2019.

the Corps to quantify impacts to fish species from the current proposal as well as from the potential future expanded mine scenario.

2. The DEIS asserts that "[t]he percentage reductions in habitat would generally decrease in a downstream direction until reaching the confluence of the NFK and the SFK (with a few exceptions). In terms of extent, rainbow trout, chum, sockeye, Dolly Varden, and Arctic grayling would have habitat decreases only in the headwater tributaries" (pg. 4.24-13). We recommend that the EIS include evidence to support this statement.

3. The Draft EFH Assessment and DEIS present miles of spawning and rearing habitats for Chinook, coho, chum, and sockeye salmon, but do not quantify overwintering, incubation, or migratory habitat. The EFH Assessment uses the Anadromous Waters Catalog to calculate spawning and rearing habitat in linear feet and miles. The Anadromous Waters Catalog covers fish spawning or presence (and less frequently migration and rearing), and it does not differentiate other critical habitats, such as overwintering habitat. Therefore, the DEIS provides an incomplete picture of fish habitat use. There is no data provided to verify the accounting of habitat miles (or acreage, by fish species) that will be impacted by the Pebble Project. We recommend that the EIS include a complete table of quantified habitat classifications by fish species documented to occur in the project impact area, to understand the amount of habitat that will be lost because of the project and the functions those habitats provide to each fish species.

Habitat Quality: The DEIS and the Draft EFH Assessment make unsupported conclusions related to habitat quality (see list below). In particular, conclusions related to "low use" and "low quality" fish habitat are not supported by the information provided in the DEIS. As discussed in the recommendations above, we recommend that the EIS conduct additional analyses of habitat characterization, function, quantification, spatial arrangement and connectivity, and the full seasonal distribution of fish species and life stages across multiple years. Once these analyses are done, we recommend that this additional information be supplied to support its conclusions. Alternatively, we recommend that the Corps explain why its existing analysis is sufficient in light of the significance and complexity of the discharge activities associated with this project. The following are specific recommendations:

1. The Draft EFH Assessment (pg. 66) states that construction of the mine site "would discharge fill material into 46,836 linear feet (14,276 linear miles)[13] of EFH catalogued as anadromous streams in the [Anadromous Waters Catalog] and/or identified by PLP research as EFH" and concludes that impacted reaches "support primarily low levels of use by rearing Chinook salmon and rearing and spawning coho salmon." The Draft EFH Assessment further states that "the NFK and SFK reaches that would be removed have a low Pacific salmon presence compared to downstream reaches indicating that these habitats are of lower quality EFH." We recommend detailed analyses or references be provided to support these conclusions regarding "low levels of use" or "low Pacific salmon presence." This supporting information is particularly important given recent research highlighting the importance of temporally and spatially shifting habitat mosaics for Pacific salmon populations in this region.[14]

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[13] There also appears to be a conversion error in these number which come from the Draft EFH Assessment.
[14] Brennan et al. 2019.